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The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

The Rating of Machinery.
(F. H. LIVENS.) THE ENGINEER, 11-2-27.

Circulating Water System at a London Electricity Works.
THE ENGINEER, 11-2-27.

The Burning of Low Grade Fuels.
THE ENGINEER, 11-2-27.

Stability of Floating Prismatic Bodies of Simple Geometric Section.
(T. B. ABELL.) THE ENGINEER, 11-2-27.

Pneumatic Coal and Ash Conveying Plant.
THE ENGINEER, 11-2-27.

Work Hardening Properties of Metals—No. II.
(E. G. HERBERT.) THE ENGINEER, 11-2-27.

A Few Observations on Railways.
(SIR FELIX POLE.) THE ENGINEER, 11-2-27.

High Pressure Steam Plants.
(MELLANBY & KERR.) THE ENGINEER, 11-2-27.

PUBLIC NOTICES

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
1. SEVEN SETS of UNDERFRAMES and BODY IRONWORK for BOGIE CARRIAGES.
2. About 78 Tons of BRIDGEWORK.
3. TWO 250 K.W. DIESEL ENGINE ALTERNATOR SETS, complete with Switchgear, Transformer, &c.
4. THREE CRANES—
Two 50 Tons Overhead, Electric Travelling, and
One 5 Tons Walking, Jib.

Tenders due on the 1st March, 1927, for No. 1; on the 8th March, 1927, for Nos. 2 and 4; and on the 22nd March, 1927, for No. 3.
Specifications and forms of Tender obtainable from the above at a fee of 5s. per set for items 1 to 3, and 5s. per set of three copies and 5s. for each further copy for item 4. These fees will not be refunded. 4740

Assistant Engineers (4) REQUIRED for the NIGERIAN GOVERNMENT RAILWAY (Survey) for a tour of 12 to 18 months, with possible extension. Free passages and a commuted bush, travelling and detention allowance of £9 a month whilst on duty in the Colony. Camp equipment provided. Outfit allowance of £60 on first appointment. Liberal leave on full salary. Salary £480 for the first three years of service, then £510, rising by annual increments to £920 a year. Candidates must have passed examination to qualify for A.M.I.C.E. or hold equivalent professional qualifications, and have had experience on railway survey, preferably location.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, mentioning this paper and quoting M/15135. 4703

Assistant Draughtsman REQUIRED, with some automobile experience: ex-Service man preferred.—Apply, stating age, experience, &c., and salary required, to C.I.M.T., 14, Grosvenor-gardens, S.W. 1 4701

Civil Service Commission. FORTHCOMING EXAMINATION. MALE CARTOGRAPHERS in the Hydrographic Department of the Admiralty (19-25, with extension in certain cases).—Regulations and particulars are obtainable from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, together with the form on which applications must be made. The latest date for the receipt of application forms is 8th March. 4618

INDIAN SERVICE OF ENGINEERS.
The Secretary of State for India in Council will in 1927 APPOINT TEN ASSISTANT EXECUTIVE ENGINEERS for this Service, including, if possible, one Burman, who will be appointed to the India recruited branch in Burma. Except for this one appointment every candidate must be a European British subject of non-Asiatic domicile.
Candidates must be not less than 21 years and not more than 24 years of age on 1st August, 1927.
They must either (1) have obtained one of certain recognised University degrees or other distinctions in engineering, or (2) have passed Sections A and B of the Associate Membership Examination of the Institution of Civil Engineers or been exempted by the Institution from such examination, or (3) have passed the Associateship in Civil Engineering of the City and Guilds Institute (Imperial College of Science and Technology, South Kensington), or (4) produce the required evidence that they are otherwise eligible under the Regulations. They must in addition have had at least one full year's practical experience of civil engineering under a qualified civil engineer at the time when they appear before the Selection Committee.
Applications from candidates must reach the India Office not later than 1st April, 1927.—Printed forms, together with information regarding the conditions of appointment, may be obtained from the SECRETARY, Services and General Department, India Office, Whitehall, London, S.W. 1.
India Office. 4339

Armstrong College,
NEWCASTLE-UPON-TYNE.
(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.SC. and the HONOURS DEGREE of B.SC. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to
THE REGISTRAR,
Armstrong College,
4329 Newcastle-upon-Tyne.

Institution of Structural Engineers.
MODIFIED EXAMINATION FOR ASSOCIATE-MEMBERSHIP.
This Examination is held quarterly for candidates of and over 25 years of age having 10 years' practical experience, including time served in articles. It consists of a problem in design with a little additional work, which is carried out by the candidate at his own home. The NEXT EXAMINATION will be held on FEBRUARY 10th, and entries should reach me before February 14th. Syllabus and full particulars from the under-noted.
MAURICE G. KIDDY, F.I.S.A.,
Secretary.
10, Upper Belgrave-street, S.W. 1. 4479

PUBLIC NOTICES

Crystal Palace School of Practical Engineering. Founded 1872.
MECHANICAL AND CIVIL ENGINEERING DIVISIONS.
PRESIDENT: J. W. WILSON, M.I.C.E., M.I.M.E.
PRINCIPAL: MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors.
Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 4347

Ashborne Urban District Council.
RODSLEY WATER SCHEME.—CONTRACT NO. 4. PUMPING MACHINERY.
The Council invite TENDERS for the complete INSTALLATION of a HIGH-CLASS PUMPING PLANT in DUPLICATE.
Each unit will comprise a Vertical Crude Oil Engine driving through gearing a Combined High-lift Vertical Centrifugal Bore-hole and Force Pump, to raise 12,500 gallons per hour against a head of 437ft. including friction, together with all Accessories, &c., to make the plant complete in every detail.
The work will also include subsidiary Plant, including Depth Recorders, Venturi Meter, Heating Apparatus and General Equipment.
Four-stroke cycle vertical engines are specified, but manufacturers may submit alternative Tenders for two-stroke cycle engines.
Copies of the conditions, specification, schedule of prices and form of Tender, prepared by the Engineer, Dr. Herbert Lapworth, M. Inst. C.E., 25, Victoria-street, Westminster, may be obtained on application to the undersigned on or after February 10th, 1927. The application must be accompanied by a sum of £5, which will be refunded on return of the documents within seven days or after the receipt of a bona fide Tender and the documents required.
Facilities for examining the drawings, for inspecting the site and general information can be obtained on application to Mr. D. Powell, M. Inst. M. and Cy E., Surveyor to the Council, Council Offices, Ashborne, Derbyshire.
Tenders are to be sent on the form supplied, and with the annexed documents must be enclosed in a sealed cover, endorsed "Rodsley Water Scheme: Tender for Contract No. 4," addressed to and reaching the undersigned not later than 10 a.m. on Monday, March 21st, 1927.
Only Tenders for vertical engines and from experienced oil engine and pump manufacturers will be considered.
The Council do not bind themselves to accept the lowest or any Tender.
R. WILLIAMS,
Clerk to the Council.
Council Offices,
Ashborne, Derbyshire,
February 1st, 1927. 4708

PUBLIC NOTICES

County Borough of Brighton.
WATERWORKS DEPARTMENT.
PATCHAM PUMPING STATION.
The Corporation invite TENDERS for the MANUFACTURE, DELIVERY, ERECTION, SETTING TO WORK, and MAINTAINING for a period of 12 months, of a TRIPLE-EXPANSION PUMPING ENGINE, WELL and FORCE PUMPS, LANCASHIRE BOILERS, SUPERHEATERS, ECONOMISER, and AUXILIARY PLANT at the above Works. The Engine to be of a capacity of 3½ million gallons per 24 hours.
Copies of the drawings, conditions of contract, specification and form of Tender may be obtained from Mr. A. B. Cathcart, M. Inst. C.E., Waterworks Engineer, 12, Bond-street, Brighton, after the 16th inst., upon receipt of a deposit of £5 5s., which will be refunded upon the submission of a bona fide Tender and the return of the documents.
Sealed Tenders, endorsed "Tender for Pumping Engine, &c., Patcham Works," must be delivered at the office of the undersigned, Town Hall, Brighton, not later than 10 a.m. on March 14th, 1927.
The Corporation do not bind themselves to accept the lowest or any Tender.
JAS. H. ROTHWELL,
Town Clerk.
Town Hall, Brighton,
9th February, 1927. 4723

Epsom Rural District Council.
BANSTEAD DRAINAGE.
CONTRACT NO. 6.
TO CONTRACTORS.
The Epsom Rural District Council are prepared to receive TENDERS for the CONSTRUCTION of about 14½ MILES of STONEWARE and CAST IRON SEWERS of 7in., 9in., and 12in. diameter, together with MANHOLES, FLUSHING TANKS, VENTILATING SHAFTS, and other appurtenant WORKS, in accordance with the plans and specification prepared by the Engineers, Messrs. John Taylor and Sons, Caxton House, Westminster, S.W. 1.
Copies of the specification, bill of quantities, and form of Tender may be obtained and the drawings may be seen at the offices of the Engineers upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.
Sealed Tenders, endorsed "Banstead Drainage, Contract No. 6," addressed to the undersigned at his office at Epsom, must be received before 10 a.m. on Wednesday, the 2nd day of March, 1927.
The Council do not bind themselves to accept the lowest or any Tender.
By Order,
(Signed) ARTHUR R. COTTON,
Clerk to the Council.
R.D.C. Council Offices,
Ashley House, Ashley-road,
Epsom, Surrey. 4716

PUBLIC NOTICES

Scarborough Corporation.
NEW IRTON WATER SCHEME.
CONTRACT NO. 10.
RESERVOIR REINFORCED CONCRETE ROOFING.
The Corporation invite from experienced reinforced concrete contractors TENDERS for the CONSTRUCTION of a REINFORCED CONCRETE ROOF, covering 7600 square yards, at Osgodby, near Scarborough.
The columns will be of pre-cast reinforced concrete, with alternative schemes for reinforced concrete roofing. The work will also include the strengthening of the existing floor, pipe laying and accessories, soiling and embanking.
Copies of the conditions, specification, schedule of prices and form of Tender, prepared by the Engineer, Dr. Herbert Lapworth, M. Inst. C.E., 25, Victoria-street, Westminster, may be obtained on application to the undersigned on or after Thursday, February 3rd. The application must be accompanied by a sum of £5, which will be refunded on return of the documents within seven days or after the receipt of a bona fide Tender and the documents required.
Facilities for examining the drawings, for inspecting the site and general information can be obtained on application to Mr. Herbert Richardson, M. Inst. W.E., the Water and Streets Engineer to the Corporation, Town Hall, Scarborough.
Tenders are to be sent in on the form supplied, and with the annexed documents must be enclosed in a sealed cover, endorsed "New Irton Water Scheme: Tender for Contract No. 10," addressed to and reaching the undersigned not later than 10 a.m. on Thursday, February 24th.
It is particularly requested that none but experienced reinforced concrete specialists should apply.
The Corporation do not bind themselves to accept the lowest or any Tender.
SYDNEY JONES,
Town Clerk.
Town Hall, Scarborough, 4643
24th January, 1927.

State Electricity Commission OF VICTORIA, AUSTRALIA.
TENDERS are hereby INVITED for the MANUFACTURE, SUPPLY and DELIVERY for the Yallourn Brown Coal Works, Victoria, Australia, of OVERBURDEN DUMP TRUCKS, in accordance with Specification No. 27/9.
Copies of Tender form, specification, &c., will be available upon application to :—
The Agent-General for Victoria,
Victoria House, The Strand,
London, England.
CHARGE.—£2 for three copies of Tender form, conditions of contract and specification complete. This charge will be returned in the event of a bona fide Tender being received. Extra copies 10s. each, not returnable.
PRELIMINARY DEPOSIT.—A preliminary deposit of £50 is to be lodged at the office of the Agent-General for Victoria.
Tenders, on prescribed form, properly endorsed and addressed, must be delivered at the office of the Commission, Melbourne, not later than 4th April, 1927.
The Commission does not bind itself to accept the lowest or any Tender.
R. LIDDELOW,
4721 Secretary.

Surrey County Council.
HIGHWAYS AND BRIDGES DEPARTMENT.
The Surrey County Council invite TENDERS for the WORKS to be carried out in the CONSTRUCTION of a FERRO-CONCRETE BRIDGE of six spans, totalling 318ft., over the Southern Railway and Upper Mulgrave-road in the Parish of Cheam.
Copies of the form of Tender, instructions to persons desirous of tendering, and bill of quantities may be obtained from the undersigned, and the form of contract, general conditions, specification and drawings may be examined at the office of the County Surveyor on weekdays (except Saturdays) from 10 a.m. to 4.30 p.m., on and after Tuesday, the 1st February, on payment of a deposit of Ten Guineas, which will be refunded upon receipt of the above-mentioned documents complete with a bona fide Tender, and each Tender must be submitted enclosed in a sealed envelope endorsed "Tender for Bridge over the Southern Railway and Upper Mulgrave-road, Cheam," and lodged not later than 9 a.m. on the 16th February, 1927.
The Council does not bind itself to accept the lowest or any Tender.
W. P. ROBINSON, A.M. Inst. C.E.,
County Surveyor.
County Hall Annexe,
Kingston-on-Thames,
27th January, 1927. 4647

PUBLIC NOTICES (continued)
Page 2.

SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
PARTNERSHIPS, Page 2.
EDUCATIONAL, Page 2.
AGENCIES, Page 2.
MISCELLANEOUS, Page 2.
AUCTIONS, Pages 3 and 84.
MACHINERY, &c., WANTED, Page 4.
FOR HIRE, Page 4.
FOR SALE, Pages 4 and 84.
PATENTS, Page 3.
BUSINESSES and PREMISES (For Sale, etc.), Page 3.
WORK WANTED, Page 4.

For Advertisement Rates see Leader Page.

INDEX TO ADVERTISEMENTS
Page 83.

PUBLIC NOTICES

City and County of Kingston-upon-Hull.
APPOINTMENT OF CHIEF ENGINEERING ASSISTANT.

The Corporation of Kingston-upon-Hull invite APPLICATIONS for the POSITION of CHIEF ENGINEERING ASSISTANT at a salary of £450 per annum (no bonus), rising by two annual increments of £25 to £500.

The person appointed will be required to devote his whole time to the duties of the office and will be required to contribute to the Corporation Superannuation Fund, and to pass a medical examination.

Particulars of duties and forms on which applications should be made may be obtained from the undersigned. Application by letter for the appointment is not essential.

Applications, endorsed "Chief Engineering Assistant," addressed to the City Engineer, Guildhall, Hull, must be delivered not later than Tuesday, the 22nd February.

T. THOMAS,
City Engineer.

Guildhall, Hull,
7th February, 1927. 4706

Park Prewett Mental Hospital,
BASINGSTOKE.

ASSISTANT ENGINEER WANTED. Candidates should possess a sound practical knowledge of Electrical and Steam-raising Plant, and be capable of supervising repairs to such plant; in addition, they must have a good working knowledge of Building Construction and Repairs, and be capable of preparing estimates and keeping works costs.

Age not to exceed 33 years.

Salary £200, with house and garden, valued at £30 per annum.

The appointment will be subject to the provisions of the Asylums Officers' Superannuation Act, 1909.

Applications, stating age, experience, &c., and marked on envelope "A.E.," must reach me not later than 24th February, 1927, together with copies of three recent testimonials.

H. SPOONER,
Clerk to the Committee.

5th February, 1927. 4710

Municipality of Singapore,
STRAITS SETTLEMENTS.
SEWERAGE DEPARTMENT.
APPOINTMENT OF ASSISTANT ENGINEER.
ADVERTISEMENT.

The Municipal Commissioners of Singapore REQUIRE an ASSISTANT ENGINEER for their Sewerage Department, age 23 to 28 years, unmarried, on a three years' agreement, with possible extension.

Applicants must have had a good general and technical education, and have served articles or gained experience under a qualified engineer engaged upon sewerage schemes.

They must have passed an examination qualifying them for Associate Membership of the Institution of Civil Engineers.

Experience in the design and construction of Main and Lateral Sewers and Sewerage details is essential; also knowledge of Gravity and Pumping Schemes, and acquaintance with Sewage Disposal Systems. Experience of Activated Sludge Systems would be an advantage.

Salary 5400 dollars for the first year, 5700 dollars for the second year, and 6000 dollars for the third year, payable monthly in Straits currency. The value of the dollar is 2s. 4d. sterling, and the pay of the appointment for the first year is therefore £630. An allowance for transport when on duty will be granted. Free passage will be provided with half pay during the voyage out. The selected candidate must pass an approved medical examination.

Applications, stating whether married or single, age, birthplace, and giving details of education, training and experience generally, with particular reference to the qualifications mentioned above, and accompanied by copies (not originals) of testimonials, to be lodged with Messrs. PEIRCE and WILLIAMS, MM. Inst. C.E., 64, Victoria-street, London, S.W. 1, Agents for the Commissioners, not later than Wednesday, 23rd February, 1927.

Further particulars, if desired, can be obtained from the Agents. 4709

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

BOX P2674, ASSISTANT ENGINEER.—ADVERTISERS THANK numerous APPLICANTS, but advise POSITION FILLED. P2758 A

WANTED, a STRUCTURAL ENGINEER, to Fill a SENIOR POST with a British Firm in India, who have Structural Steel and General Engineering Works. Should have A.M.I.C.E. or equivalent qualifications. Must have had good technical training, also drawing-office and workshop experience. Age 30 to 35.

Good salary and prospects to a suitable man.
Address, P2771, The Engineer Office. P2771 A

WANTED, INSPECTION SUPERINTENDENT for Mechanical Side of large firm of Commercial Motor Vehicle Manufacturers; capable of controlling all inspection work on component parts and the testing of units and finished chassis; must be good organiser with first-class experience.—Address, stating age and salary required, 4645, The Engineer Office. 4645 A

ADVERTISING AND CATALOGUES.—WANTED, A smart PUBLICITY MAN, with good ideas and initiative, for Engineering Firm. State qualifications, age, wages, and enclose, if possible, samples of original work. Applications treated in strict confidence.—Address, I-2766, The Engineer Office. P2766 A

APPLICATIONS are INVITED for a VACANCY in the SALES DEPARTMENT of an Engineering Concern in India. Only individuals of robust physique and good personality who have been educated at a good class school, have served apprenticeship, and had sound technical education need apply. Age not over 25, unmarried.—Write, Box 713, Leathwait and Simmons, 34, Throgmorton-street, E.C. 2. P2762 A

ASSISTANT CIVIL ENGINEER WANTED for Railway Construction in Portuguese West Africa.—Send full particulars previous experience and copies references to Box 2890, care Brown's, 30, Tothill-street, Westminster, S.W. 1. 4738 A

BOILER-HOUSE SUPERINTENDENT REQUIRED for large London industrial plant, capacity about 200,000 lb. evaporation per hour.—Write, stating age, salary required, and full details of experience, to Box Z. M. 607, c/o Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3. 4727 A

CONTRACTOR'S AGENT WANTED for Job near London; extensive experience in Reinforced Concrete essential.—Address, stating age, experience and salary required, 4649, The Engineer Office. 4649 A

INSTRUMENT MAKER WANTED, Preferably with electrical and optical training; must have had good all-round experience and be capable of doing high-class work. Permanency for suitable man.—Apply, SECRETARY, Experimental Department, Fine Cotton Spinners' and Doublers' Association, Rock Bank, Bollington, Macclesfield. 4733 A

WORKS ENGINEER REQUIRED, Able to Undertake Lay-out and Supervision of Sheet Rolling Works in Staffordshire area. Must be under 40 and capable of taking full charge and control.—Apply in first instance in confidence by letter to NOEL W. GREENWAY, M.I. Mech. E., Consulting Engineer, Lloyd's Bank Chambers, New-street, Birmingham. 4735 A

WANTED, a First-rate DRAUGHTSMAN, Experienced in Gas and Chemical Plant for Contractor's work.—State age, experience and salary expected to R. and J. DEMPSTER, Ltd., Oldham-road, Manchester. 4652 A

ARNOLD BOOKS

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Professor of Architecture and Building in the Royal Technical College, Glasgow. With 72 full-page Plates. SECOND EDITION. Large 4to. 8s. net.

LONDON EDWARD ARNOLD & CO. 41 & 43 MADDOX ST., W.

SITUATIONS OPEN (continued)

WANTED, Experienced ASSISTANT DRAUGHTSMAN; must be thoroughly used to Railway Carriage and Wagon Work. Age 25 to 35.—Apply, stating qualifications and salary required, to Messrs. CHARLES ROBERTS and CO., Ltd., Horbury Junction, near Wakefield. 4729 A

WANTED, EXPERIENCED DRAUGHTSMEN for large Marine Engine Works on North-East Coast for Steam and Oil Engines, also Boilers and Pipe-work.—Address applications, stating age, experience, and salary required, to 4711, The Engineer Office. 4711 A

WANTED for Works in South of England, Experienced DRAUGHTSMAN, used to Refrigerating Work. Send full particulars of experience, age, and salary required.—Address, 4724, The Engineer Office. 4724 A

WANTED, JUNIOR DRAUGHTSMEN for Crane and Conveyor Work in large works in Leicestershire.—Address, stating age, qualifications, when at liberty, and salary desired, to 4719, The Engineer Office. 4719 A

DRAUGHTSMAN, Junior, with Workshop Experience and good education, to specialise in the design and superintendence of Automatic, Semi-automatic, and other Labour-saving Devices, also to Assist Principal generally. London district. Progressive position. State age, schooling, full particulars of experience, salary required, and enclose copies of testimonials.—Address, P2778, The Engineer Office. P2778 A

DRAUGHTSMEN, — SENIOR and JUNIOR DRAUGHTSMEN REQUIRED for N.E. Coast, with knowledge of Electric and Hydraulic Cranes, Hoists, &c.—Address, stating age, experience, and salary required, to 4712, The Engineer Office. 4712 A

DRAUGHTSMEN WANTED, First Class, Used to Commercial Vehicle Work. Must have had good shop experience. (London area.)—Address, stating age, salary, and full details of experience, 4699, The Engineer Office. 4699 A

DRAUGHTSMAN WANTED, Used to Plant and Conveyor Work, for light production. (London area.)—Address, stating age, salary, and full details of experience, 4700, The Engineer Office. 4700 A

DRAUGHTSMAN, with First-class Experience in Power Plant Details and Design, Water-tube Boilers, Chain-grate Stokers, Pulverised Fuel Machinery, Coal and Ash-handling Plants, &c. Permanent and progressive position to suitable man.—Address, giving full details as to experience, references, commencing salary desired, when at liberty, 4730, The Engineer Office. 4730 A

LARGE and Old-established Firm of Constructional Engineers in India REQUIRE a STRUCTURAL DRAUGHTSMAN; age under 23; unmarried. Reply, giving fullest details, education, engineering experience, present class work, and present salary, to Box Z. G. 623, c/o Deacon's, Fenchurch-avenue, London, E.C. 3. 4723 A

REQUIRED, the SERVICES of a YOUNG ENGINEER DRAUGHTSMAN, to work out details of Patent Apparatus for Ship Service, under supervision of patentee. Must have actual marine design experience. Good education and address imperative, with view to subsequent employment on commercial side, interviewing, demonstrating, &c. State salary, training and experience, with references in full.—Address, 4705, The Engineer Office. 4705 A

STRUCTURAL DRAUGHTSMAN REQUIRED by British Firm in India. Must have had good technical training, be able to work out stresses, prepare designs, estimates and detail drawings of Roof, Bridge and General Structural Steel Work. Must be a bachelor, age 23 to 27.—Apply, stating age and particulars of experience, to Z. T. 633, c/o Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3. 4728 A

STRUCTURAL DRAUGHTSMAN REQUIRED. Only fully experienced men need apply. State age and salary required and full particulars of experience and when at liberty. West Riding of Yorkshire.—Address, P2755, The Engineer Office. P2755 A

STRUCTURAL STEEL WORK.—WANTED, a DETAIL DRAUGHTSMAN, also a DESIGNER to 1909 Act. Must be neat and accurate and men with experience and good character.—Apply by letter only to YOUNG and CO., 6, Queen Anne's-gate, London, S.W. 1. P2777 A

SITUATIONS WANTED

ADVERTISER (28), Single, Ambitious, Technical and works training in mechanical and electrical, DESIRES POST with prospects, home or abroad.—Address, P2687, The Engineer Office. P2687 B

CIVIL ENGINEER, A.M.I.C.E. (Middle-aged), will be OPEN for ENGAGEMENT end of Feb. Extensive experience home and U.S.A. on surveys, designs and responsibly in charge of construction of public works of a varied character—roads and land development, water supply with impounding and service reservoirs, large mains, &c., drainage embracing tunnel sewers and disposal works, piling and general construction. Located London.—Address, P2747, The Engineer Office. P2747 B

CIVIL ENGINEER, SURVEYOR and DRAUGHTSMAN; tropical, Canadian and home experience, general constn., including oil, gas, mines; expert rush jobs.—Address, P2780, The Engineer Office. P2780 B

ENGINEER and DRAUGHTSMAN, London, 12 years' shops, 14 years' office; all-round experience, including patents; or PRIVATE WORK UNDERTAKEN.—Address, P2770, The Engineer Office. P2770 B

ENGINEER, with Large Experience, Home and Abroad, SEEKS POSITION as ERECTOR or MAINTENANCE ENGINEER, Power Plant, Cold Stores, Steelwork, &c. Knowledge of Spanish.—Address, P2765, The Engineer Office. P2765 B

POSITION REQUIRED with Manufacturers, Contractors, Gen. Eng., Railway Material, Plant, Exp. home and abroad; ex. general and works manager. Speaks Spanish; age 40.—Address, P2340, The Engineer Office. P2340 B

SALES ENGINEER, A.M.I. Mech. E., 34, Experienced all phases of selling, correspondence, management, instruction, control of salesmen. Successful record as business getter and negotiator. Knowledge French, German. Complete control or Assist. Sales Manager.—Address, P2761, The Engineer Office. P2761 B

STRUCTURAL and GENERAL ENGINEER (45), single, 12 years' Eastern experience in fabrication and erection of steel and reinforced structures, wagons, bridges, &c., good organiser, DESIRES POST as MANAGER. Ex. references.—Address, P2775, The Engineer Office. P2775 B

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Foreign Naval Contracts.

IT is understood that all the shipbuilding firms, British and continental, which were invited to bid for the Chilean destroyer contract have now submitted their tenders to the Chilean Naval Commission in London, which will forward them to Valparaiso for the final decision. The proposal embraces six vessels, reported to be of a large and powerful type. The conditions specified were exceptionally onerous, with regard to steaming and endurance capacity, but in view of the very large number of firms competing for the work there is no doubt that the prices quoted will be extraordinarily moderate. There is every hope that British industry will secure at least a portion of this contract, thanks to the high reputation enjoyed by several of our leading firms as builders of fast and seaworthy destroyers. It will be recalled that both the Dutch and the Roumanian Governments recently selected British plans for their new destroyers in preference to those offered by continental designers. Moreover, the finest destroyers now serving in the Chilean Fleet, and indeed practically all the modern units of that fleet, are of British design and construction. Credits are also to be opened in Chile for new cruisers and submarines, tenders for which are soon to be invited. The Argentine Government has been authorised to spend a large sum on renovating the national fleet, and is now preparing plans for new ships, including cruisers of the 10,000-ton class, destroyers and submarines. It is stated that American builders are confident of securing the lion's share of this work, but we understand that British and continental firms will also be asked to tender for the vessels. It is possible, therefore, that British shipyards during the present year may receive some valuable naval contracts from abroad.

Spanish Motor Car Industry.

IT is stated that the Spanish Government is taking steps to develop a national motor car industry, by, in the first place, ordering from a British firm 300 cars which are to be assembled in Spain with imported parts. At the same time, the British maker is to be authorised to import the machine tools necessary for the manufacture of similar parts, so that eventually the complete vehicles may be made in the country. This scheme is in accordance with the policy now being pursued in Spain of granting concessions to foreign firms for the creation of new industries. There is a noticeable re-awakening of engineering activity in Spain as the result of the probable carrying out at an early date of vast public works schemes, and of the protectionist policy which aims at excluding practically everything that can be produced in the country. If the plans of the Government can be realised, there will doubtless be a considerable demand for machinery and plant for the equipment of factories. The business of organising the aircraft industry has already been placed in the hands of the Germans.

Wages of Coal Miners in Belgium.

IN spite of the slow, but sure reduction in the price of coal in Belgium, owing largely to the renewal of British and German competition, the wages of the miners were increased by 5 per cent. from the 5th of the present month. This increase has been brought about automatically by the increase of the index figure upon which the basic wage is founded. The index figure is computed by adding three-quarters of the Government's "index of price of commodities" to one-quarter of five times the price of coal. Thus, as the standard price of coal in December was 175f., and the commodity index on January 15th was 755, a little calculation will show that the index upon which the wages for February are based is 785. The previous index, computed in a similar fashion, was 748. The method of basing miners' wages, both on the cost of coal and the cost of living, as in Belgium, would seem to tend towards a doubly vicious circle. High wages mean both dear coal and an increase in the cost of living, both of which under the Belgian method help to force the miners' wage level higher still. Whatever may have been the defects in detail of the agreement arrived at in this country a few years ago for automatic wage adjustment in the coalfields, the principle that the profits of the industry rather than the price of coal should govern wages was eminently sound, as it encouraged all concerned to strive for efficiency of production rather than to endeavour to make coal as dear as possible.

Electricity Supply.

A FEW days ago it was announced by the Minister of Transport that Sir James Devonshire, Mr. Frank Hodges, Sir James Lithgow, Alderman W. Walker, Sir Duncan Watson, Mr. W. K. Whigham, and Brevet-Colonel the Hon. Vernon Willey had been appointed to fill the seven places on the Central Electricity Board under the chairmanship of Sir Andrew Duncan. The Central Electricity Board has been established under the Electricity (Supply) Act, which was passed last year. Sec. 1 of the Act lays the duty of the appointment of the Chairman and the seven members of the Board on the Minister of Transport, after consultation with such representatives of local government, electricity, commerce, industry, transport, agriculture and labour as the Minister may think fit. Neither the Chairman nor any member of the Board may be a member of the House of Commons. The Chairman and members, the Act states, shall hold office for such a term, not less than five years nor more than ten years, as may be determined by the Minister. The chief duties of the Board are to supply electricity to authorised undertakers and to approve technical schemes submitted by the Electricity Commissioners.

The Reconditioned Mauretania.

THE Cunard liner Mauretania, which was recently overhauled and reconditioned at Liverpool, arrived at Southampton on Sunday afternoon. Early the same morning a speed trial was carried out in the English Channel, and for two hours a speed of 26 knots was easily maintained. The result of this short run seemed to indicate that the Mauretania possesses as good a speed as ever, and that for some years to come the task of wresting from her the "blue riband" of the Atlantic will, at least, be a difficult one. The main work done at Liverpool consisted of improvements in the passenger and public room accommodation, and 100 state rooms were re-planned. A good deal of this work was carried out by the repair department of the Cunard Company. The overhaul and survey of the main turbines, auxiliary machinery and boilers was, however, entrusted to Charles Howson and Co., Ltd., of Regent-road, Huskisson Dock, Liverpool, which firm also carried out the new electrical and plumbing work required in the ship. The high-pressure and low-pressure turbines were opened up and inspected, and the boilers were cleaned. Other work included the fitting of two new propellers and one tail shaft, while a new 670-ton oil fuel bunker was added, which brings up the total oil fuel carrying capacity of the ship to over 7000 tons. After completing her first round trip the Mauretania will undertake a cruise to the Mediterranean before taking up her scheduled service between Southampton and New York.

Important Oil Tanker Orders.

IMPORTANT orders for six oil tank vessels for the Gulf Refining Company, of Pittsburg, America, totalling £1,000,000 in value, have been secured by British shipbuilders in the face of strong continental and American competition. Three ships, the largest yet ordered on the Tees, will be built on the Isherwood "bracketless" system by the Furness Shipbuilding Company, Ltd., of Haverton Hill-on-Tees. They will each have a deadweight carrying capacity of 15,000 tons, and will be propelled by Doxford type oil engines, which will be constructed by Richardsons, Westgarth and Co., Ltd., of West Hartlepool. The same firm is to build the steam machinery for three twin-screw oil tank steamers, each of about 3700 tons deadweight carrying capacity, for the same owners, which will also be constructed on the Isherwood system, and which will be built by Palmer's Shipbuilding and Iron Company, Ltd., at Jarrow-on-Tyne. The negotiations for these orders were, we understand, carried out by Sir Joseph W. Isherwood, who will supervise the construction of the vessels. Other recently placed orders for oil tank vessels include two for motor tankers ordered by Imperial Oil, Ltd., of Toronto, which were placed with Alexander Stephen and Sons, Ltd., of Linthouse, while at Belfast, Harland and Wolff, Ltd., are to build two oil tank steamers, each of about 2300 tons deadweight carrying capacity, for the Anglo-Saxon Petroleum Company, Ltd., of London.

Empire Airship Routes.

RAPID progress is being made with the ground organisation for the experimental airship service which is shortly to be begun between this country and India. At Cardington, the airship shed built during the war has been enlarged to accommodate vessels of the 5,000,000 cubic foot capacity type now under construction in this country, and the mooring tower, 200ft. in height, has been completed and tested. At Ismailia, in Egypt, an intermediate station, a similar tower has been erected and a hydrogen producing plant laid down. At Karachi, the base in India, the huge shed described in our issue of December 24th, 1926, is being assembled, although as yet we have received no information as to the placing of the contract for the mooring tower, which it is also intended to erect at that point. The service to India is only to form a beginning of the programme of experimental work. It is hoped that the possibilities of airship routes to Australia, New Zealand, South Africa and Canada will, with the co-operation of the Dominion Governments, be explored. Promises of such co-operation have already been secured, and an officer of the Airship Department of the Air Ministry is now on his way to the west coast of Africa to survey the possibility of establishing intermediate stations with mooring towers at Freetown, Sierra Leone, and Bathurst, British Gambia. Mombasa will be visited at a later date, with a view to the establishment of an east coast route, and Durban and Cape Town will be surveyed as possible bases. The same officer, joined by two others from the Air Ministry, will then proceed to Australia, in which country Perth and Melbourne have been suggested as suitable bases. New Zealand and Canada are for the moment outside the field of the survey being undertaken, but it is possible that later on these Dominions will also indicate their desire to co-operate in the development of Empire airship routes.

A Speed Record.

CONSIDERABLE prominence has been given to the performance achieved by Captain Malcolm Campbell on Friday of last week, whereby he becomes the holder of the official world's record for speed on a motor car for both a flying kilometre and a flying mile. His mean time for an up and a down run over the one-mile course is recorded at 20·663 seconds, equivalent to a speed of 174·224 miles an hour. His car was a Napier-Campbell, driven by a 500 horse-power Napier "Lion" aero-engine. While we admit that the speed achieved is remarkable for a machine travelling on wheels, we are not disposed to feel any undue enthusiasm for the fact that it is claimed to be a record. We are not aware of the precise method adopted for measuring the interval of time returned as 20·663 seconds, but unless it involved the use of refined electrical contacts or other means analogous to those employed for measuring the velocity of projectiles, the second and third place of decimals in the figure, and very probably even the first, are open to suspicion. No method making use of a stop watch could give a measure of time to the third place of decimals. The ordinary fifth-second stop watch has a balance wheel which makes five oscillations a second, and since the escapement action is intermittent, the position of the hand has no significance except at the exact fifth-second graduations. A stop watch capable of being read to the thousandth part of a second would require to have a balance wheel making a thousand oscillations per second. The previous motor car speed record was held by Mr. Parry Thomas, with a mean mile speed of, officially, 170·624 miles an hour. Captain Campbell's feat consists of doing the mile in 0·436 second less than Mr. Thomas. That figure speaks for itself, as regards both the merits of the achievement and the accuracy which is required in the means of observing the time interval for the runs.

Television.

AT St. Andrew's Hall, Glasgow, Mr. J. L. Baird recently delivered a lecture on television. With the assistance of the lantern, he described the historical development of television in Europe and America, and the various theories and devices which served as a starting point for his own experiments, which led to the evolution of the Baird televisor, with its ability to turn images into electric currents and by that means instantaneously reproduced them in a receiving instrument. Some of the principles and actions involved in the complete television process were demonstrated and visible and invisible shafts of light playing on a sensitive cell were made to operate a loud speaker. Some of these sounds have been captured by a phonograph and the audience was given an audition of the sounds emitted by various objects. One of the records which represented a human face gave weird pulsing vibrations, a pair of scissors gave a hissing sound, a match-box a sound like a series of chuckles, and a cabbage was rendered in terms of irregular shrieks. No demonstrations of the complete television process were given, but diagrams were shown and explanations made by the inventor.

Changes in the Motor Manufacturing Industry.

Two new arrangements of firms' interests which take their rise from unfortunate experiences in the business of motor car manufacturing are announced. The old-established firm of Gwynnes Engineering Company, Ltd., whose motor car works at Chiswick were disposed of some time ago, has continued the business of manufacturing pumping machinery at its Hammersmith works, which were founded in 1849. A new company has now been registered under the style and title of Gwynnes Pumps, Ltd., to carry on this business, and from February 1st it took charge of the works. A working arrangement has been made with William Foster and Co., Ltd., of Lincoln. The manufacturing side of Gwynnes Pumps, Ltd., will ultimately be transferred to the more convenient and commodious works of Messrs. Foster at Lincoln, and Mr. Nevile Gwynne and Mr. Charles Armitage will join the board of directors of William Foster and Co., Ltd. It was also announced on Wednesday last that Mr. W. R. Morris, of Cowley, Oxford, had purchased the assets of Wolseley Motors, Ltd. Mr. Morris states that the title of the firm will be unchanged as well as the car. Mr. Morris's purchase prevents these old-established works from passing out of British hands.

The Rating and Valuation Act, 1925.

By F. H. LIVENS, M. Inst. C.E., M.I. Mech. E.

THE Rating and Valuation Act of 1925 effects most important alterations in the administration and amendment of rating law, in that it repeals entirely ten existing Acts and partially repeals thirty-six others, commencing with the Poor Relief Act of Elizabeth 43, Cap. 2, dated 1601. Assessment under the foregoing fixes the basis of other rating, and is the estimate of the net annual value of the hereditament, that is to say, the rent at which the same might reasonably be expected to let from year to year, free of all usual tenants' rates and taxes (which the tenant pays), and deducting therefrom the probably average annual cost of the repairs, insurance, and other expenses necessary.

Consideration of the alterations made in the system of assessment of buildings containing machinery is of the utmost importance to manufacturers, engineers and all using machinery. A Committee was appointed to prepare a Statement as to what should be included in the assessment of the hereditament, and has issued a report which requires the most careful examination, with a view to making every reasonable representation to the Minister before the "Statement" is ordered to take effect.

The provisions for the valuation of such hereditaments containing machinery and plant is as follows :—

Section 24.

(1) For the purpose of the making or revision of valuation lists under this part of this Act, the following provisions shall have effect with respect to the valuation of any hereditament other than a hereditament the value of which is ascertained by reference to the accounts, receipts or profits of the undertaking carried on therein :

(*a*) All such plant or machinery in or on the hereditament as belongs to any of the classes specified in the Third Schedule to this Act shall be deemed to be a part of the hereditament.

(*b*) Subject as aforesaid, no account shall be taken of the value of any plant or machinery in or on the hereditament.

The remaining sub-sections of Section 24 may be summarised thus :—

(2) The right of the occupier to be furnished with particulars in writing showing what machinery or plant has been treated as forming part of the hereditament.

(3) The appointment of the Committee of five to draw up the statement or report now under consideration.

(4) The publication of such statement by the Minister.

(5) The Order which may be made in respect thereto by which it will have effect in lieu of the third schedule of the Act.

(6) The provision for the subsequent revision of the statement at such intervals as the Minister may direct.

(7) The appointment of a panel of referees to consider objections as to the inclusion of any particular plant.

(8) Appointment of such referees by the Lord Chief Justice and fixing of fees.

(9) The power or duty of a referee to inspect the machinery over which question may have arisen, his award being final.

And lastly :—

(10) Nothing in this section shall affect the law or practice with regard to the valuation of hereditaments the value of which is ascertained by reference to the accounts, receipts or profits of an undertaking carried on therein, or be taken to extend the class of property which is under the law and practice as in force at the commencement of this Act deemed to be provided by the occupier and to form part of his capital.

This last clause may be expressed shortly :—That the law or practice of valuation under (1) as existing at the commencement of this Act shall not be affected nor shall the class of property deemed to be provided by the occupier be extended.

This being so, a clearer understanding of the situation will be obtained if a brief review be made first of the existing practice of rating hereditaments containing machinery as developed from the general Acts, by amendments and additions made from time to time by the Law Courts, in regard to the actual value of the same.

FACTORY RATING.

Where rent is paid by an occupier to the landlord the computation is easy, but if the occupier be also the owner, the assessment becomes "hypothetical," and is particularly so when the building contains machinery. When such machinery was of a simple character, as in a smithy, or a water mill, or a brew house, it was not difficult to assess the rateable value of the whole; it would include, generally speaking, all things which were part of or fixed to the structure, whilst loose utensils or tools found by the tenant would not be considered.

Towards the end of the eighteenth century, owing to the development of steam power, machinery became more varied and important, and questions arose continually, which had to be settled by the Courts. For instance, in 1783, the assessment of a house containing the working parts of a public weighing machine was raised from £5 to £24, and the Court confirmed the increase. In 1787, where a building was let with a carding machine, not fixed to the premises, but capable of being removed at pleasure, it was held that although the building was only rated at £2 2s. per year, the proper rate with the machine as one entire subject was £36.

From this date onward assessments took into account the presence of machinery, and decisions were generally in favour of the rating authority, and against the occupier. By 1840, apparently, there had arisen a disposition to assess him even on the profits which he was assumed to make from his stock-in-trade or business, but the Act of that year made it unlawful for the overseers of any parish to tax any inhabitant as such "in respect of his ability derived from the profits of stock-in-trade or any other property," and thereby he gained some relief. It should be noted, however, that if his profits were left out of consideration his losses were also, with the effect that however badly his business might be doing he had the same rate to pay.

The precise settlement of what was to be actually included in the assumed rent was still unfixed, and valuations differed in various parts of the country. Generally, the boiler and chimney with its steam engine and main shaft would be rated, but in Birmingham it was the custom to omit any increases in value attributable to machinery not permanently fixed to the premises, and balks of timber were built in ingeniously to which even a steam engine could be bolted and made exempt because it could be lifted off its foundations without interfering with the freehold. In 1837 a rate was quashed by the Court on appeal by a gas company because of this practice, and this led definitely to the inclusion in the assessment of the rent, of the enhanced value due to the presence of the occupier's machinery, whether attached to the building or not, although *per se* this machinery was not rateable. During the subsequent seventy years the Courts continually decided in favour of this addition, the culminating case being that of Kirby *v.* Hunslet Union in 1906. It was taken to the House of Lords, which upheld the principle on the ground that such machinery was necessary as adapting the building for the purpose for which it was "hypothetically" let and actually occupied. There have been subsequent decisions on the same lines.

FACTORY VALUATION.

As regards valuation, the method is as follows :—Where the owner is the occupier, first the land is valued at the price current in its locality and a suitable percentage allowed thereon, as the minimum rent which the landlord would require; then the buildings are taken similarly and such percentage on the cost is allowed, as would satisfy the rent, their depreciated value being substituted if they are not new; in like manner the machinery supposed to have been put in by the "hypothetical" landlord and let with the hereditaments is valued and a percentage taken to fix its rent; the percentages roughly vary inversely according to the supposed permanence of the investment and the three figures thus found, namely, for land, buildings and machinery, are put together, with an addition for the "enhanced value" created by the occupier's machinery. The addition consists of a percentage on the assumed value of this machinery, which may be at the rate of one-fourth or more of the percentage assessed on the value of the machinery of the "hypothetical" landlord; the sum of the four percentages, with some adjustment, perhaps, forms the net "hypothetical" rent or rateable value.

In practice, there is much uncertainty in computing the "enhancement." The valuation is rough and the percentage the valuer chooses to put on cannot be checked, so that the final exaction becomes often a matter of bargaining, and, generally, where no favouring corresponding assessment can be adduced, the valuer wins. As regards the percentage allowed between the "net" and "gross" valuations, this is of no particular moment to the owner ratepayer, as he has to pay all outgoings in the way of insurance, repairs, renewals, &c., for his "hypothetical" landlord clearly cannot help him. But it may be noted that an excessive margin between the "net" and "gross" will hamper the occupier in any appeal for reduction.

This Act, however, will help him by sweeping away the vexed question of enhancement, but will more definitely specify the machinery which may be rated as part of the hereditament, and it will be most necessary therefore to watch the scheduling and the values attached to the items. The hereditament must still be valued as a whole in accordance with existing practice and law, and as the change will tend towards more rigid methods, it may be doubted whether the ratepayer's burden will be adequately reduced. His real benefit will arise in the freedom from rating of additions to and renewals of his own machinery.

The ratepayer, furthermore, will have a more impartial representation, though small, on the Assessment Committee, as one-fifth of it must not be connected either with the Council or the Guardians.

RATEABLE MACHINERY.

Passing now to what machinery is to be rated, the classification is prescribed in Sec. 24, Sub-section (1), Clauses (*a*) and (*b*)—see above—the former instituting the Third Schedule, which defines the "Classes of Machinery and Plant to be Deemed to be Part of the Hereditament," as follows :—

1. Machinery and plant (together with the shafting, pipes, cables, wires and other appliances and structures accessory thereto) which is used or intended to be used, mainly or exclusively in connection with any of the following purposes, that is to say :—

(*a*) The generation, storage, primary transformation or main transmission of power in or on the hereditament; or

(*b*) The heating, cooling, ventilating, lighting, draining or supplying of water to the land or buildings of which the hereditament consists, or the protecting of the hereditament from fire;

Provided that, in the case of machinery or plant which is in or on the hereditament for the purpose of manufacturing operations or trade processes, the fact that it is used in connection with those operations or processes for the purpose of heating, cooling, ventilating, lighting, supplying water or protecting from fire shall not cause it to be treated as falling within the classes of machinery or plant specified in this Schedule.

2. Lifts and elevators mainly or usually used for passengers.

3. Railway and tramway lines and tracks.

4. Such part of any plant or any combination of plant and machinery, including gas holders, blast-furnaces, coke ovens, tar-distilling plant, cupolas, water towers with tanks, as is, or is in the nature of a building or structure.

1. Commenting upon the foregoing, the intention appears to be to confine the machinery to be rated as part of the hereditament to that which would correspond to what a landlord would supply where he had to find motive power and main shafting, and such additions to the structure of the buildings with the necessary mechanical parts as would fit them for the trade which the tenant would carry on; to include also the electrical or other power and/or transmission, as used to-day.

It should be noted particularly that in Sub-section 1, paragraph (*a*) the words used are "primary transformation or main transmission of power in or on the hereditament." Surely "primary" and "main" have been introduced to distinguish what is to be rated, from secondary or other transformers and transmissions appertaining to the machinery provided by the tenant and not to be rated. For instance, the countershaft of a lathe, as well as the machine itself would certainly come under the latter heading, whether driven by belt or provided with its own motor, and should not a group of lathes so driven with their motor be similarly exempted?

The next point to note in the same sub-section is paragraph (*b*), where the "heating, cooling, ventilating, lighting, draining or supply of water to the land or buildings," &c., are, generally speaking, what the tenant would require and take to, and would include the machinery necessary therefore, but not more on account of the exemption in the paragraph following (*b*).

This exemption expressly provides that where in the case of machinery or plant on the hereditament for the purpose of manufacturing operations or trade processes, the fact that it is used in connection with those operations or processes for the purpose of heating, cooling, ventilating, lighting, supplying water or protecting from fire shall not cause it to be treated as falling within the class of machinery or plant specified in this schedule, *i.e.*, liable to rating, as part of the hereditament.

The exception is important as it definitely shuts out the inclusion of machinery used for trade or manufacturing purposes, even though it performs like operations to that scheduled under (*b*), and relieves the tenant from being so rated where the operations or processes he carries on demand extra provisions of the kind named.

Looked at from a welfare point of view, however, the exemption might well have been carried further by the Ministry of Health, for if every addition of machinery for adding to the comfort and sanitary fitness of a building is to be made the cause of an increase in the rating, the occupier is not thereby encouraged to undertake the outlay.

2. "Lifts and elevators mainly or usually used for passengers," are to be included. The inference therefore is that where these are used for goods or in the operation of the workshop or manufacture, they are not to be rated. Likewise, with the movable parts of a "traveller," the fixed gantry going with the building.

3. "Railway and tramway lines and tracks." These have already been declared to be rateable, so that there is no change; but it may be pointed out that a locomotive and wagons used on the railway lines are not rateable.

4. "Such part of the plant or any combination of plant and machinery including gas holders, blast-furnaces, coke ovens, &c., as is or is in the nature of a building or structure," are to be deemed as part of the hereditament, and this would appear to be reasonable, provided that by the term "structure" is really meant an edifice of the nature of a building. "Structure" in itself is too vague and might describe the sticks or tripod from which a pot is suspended.

On the whole, therefore, if the suggested interpretation of the Third Schedule be correct, discrimination between the classes of machinery which must belong to the hereditament and those which will not is not only reasonable but fairly simple, and though there will be exceptions presenting difficulty, they should not be in large proportion.

Sub-section 5 of the Sec. 24 gives the Minister power to substitute the statement prepared by the Committee of five for the Third Schedule to this Act, and Sub-section 6 provides for the subsequent revision of the statement at such intervals as the Minister may direct, which likewise will take effect in substitution of the Third Schedule.

The proper interpretation of this schedule, therefore, as regards the rating of hereditaments containing machinery is absolutely vital, and it is necessary to

scrutinise most carefully the statement of report of the Committee recently published.

STATEMENT OF THE COMMITTEE REGARDING THE CLASSES OF MACHINERY AND PLANT TO BE DEEMED TO BE PART OF THE HEREDITAMENT.

On February 26th, 1926, a Committee was appointed to prepare a statement in accordance with the provisions of Sec. 24 of the Act, setting out in detail all the machinery and plant which appeared to it to fall within any of the classes specified in the Third Schedule. The Chairman of this Committee was the Right Hon. Edward Shortt, K.C., and the members Messrs. Arthur Body, W. Craig Henderson, K.C., W. H. Patchell and A. H. Preece. Its statement was issued a few weeks ago, and can be obtained from H.M. Stationery Office for 1d. We assume that all engineers who are interested have copies of it.

It may be observed, in the first place, that the members of the Committee were not in agreement, as is evident from the note at the foot of page 4 of the report, where the Chairman expresses his inability to concur with what is set down in Class 6.

Secondly, that the arrangement and/or classification of the Third Schedule has been departed from, and that the statement is much more difficult to follow. It begins thus :—

CLASS 1.

Machinery or plant specified in Sections (*a*) to (*m*) of this Class—

(i.) When used or intended to be used mainly or exclusively in connection with the generation or storage of power ; or

(ii.) When used or intended to be used mainly or exclusively in connection with the transformation or transmission of power and when forming part of the scheme or chain of all transformation and transmission of power (hereinafter called the chain of power) between the generating plant in or on the hereditament, or the point or points at which power is supplied to the hereditament, and . . ."

Then follow two alternative directions or conditions —which can only be properly appreciated or understood by a study of the text of the statement—with a qualifying proviso succeeding them, which exempts apparatus for transforming electrical pressure "at the medium or low-pressure omnibus bars " to another pressure. In other words, all the occupier's electric plant and mains appear to be included in the hereditament, except any required for what may be termed an exceptional transformation of current, and he is deprived of the advantage which the words "primary" and "main " in the Third Schedule 1 (*a*) were intended to confer upon him. It is obvious that the clause should be re-drafted to give effect to these words.

It does not appear equitable that if electric current is delivered by a supply company at so high a voltage that the occupier cannot use it, that he should be rated on the transformer which brings the current down to a usable voltage. In any case, he should not have to pay more for the latter than for a like supply in the neighbourhood in which transformer is not included in the rateable value.

Taking Secs. (*a*) to (*m*) mentioned above, elaborating the classes of machinery and details which are to be included in the rating, these appear to be drawn up so as to include everything possible, and additionally Sec. (1) specially draws in "machinery or plant when used or intended to be used in connection with the handling, preparing or storing of fuel." Supposing, however, such fuel is to be used not for power, but for "manufacturing operations or trade processes," should not all such machinery for dealing with it be exempted ? Pages 6 and 7 of the statement require most careful consideration.

CLASS 2.

Machinery and plant covered by this clause are as generally set out in 1 (*b*) of the Third Schedule, and the exempting clause—following (*b*)—and a list of possible items is annexed, some of which at least would be otherwise exempted if used for "manufacturing operations or trade processes." Whilst " electric lamps " for general lighting may go with the hereditament, surely there are many lights which are in the nature of tenant's temporary or portable fixtures and should be excluded ! The schedule should be reconsidered.

CLASSES 3 TO 6.

Class 3 which specifies rateable steam or other motors may be passed ; so may Class 4, being Class 2 in the Third Schedule, and Class 5, which is Class 3 in the same ; but Class 6, elaborated apparently from Class 4, appears to include a large amount of machinery and plant which can only be used for "manufacturing operations or trade processes," and cannot exist without some sort of structure ; but, on the other hand, are in no way a building or part of the hereditament—see Chidley *v.* West Ham (1874), in which a decision in favour of the tenant was given as regards tanks resting on girders, refrigerators, pumps, distilling apparatus, &c., and Blackburn, J., said, "All the items thus are nothing more than chattels, and not rateable as part of the premises." In view also of the Chairman's disagreement, this class should be revised drastically.

CONCLUSION.

The points raised are so vital in character that it is absolutely necessary for the Statement to be carefully gone through by experts conversant with electric and power plant, and the inequalities involved in the rating of buildings containing machinery in various parts of the country from the occupier's point of view.

The Stability of Floating Prismatic Bodies of Simple Geometric Section.

By Professor T. B. ABELL.

WHILST an examination of the stability of prismatic bodies of geometric section will not provide direct assistance to estimate the stability of ships, it will afford a useful guide for assessing in a general qualitative way the effect of variation of the shape of ships' sections in the neighbourhood of the water plane. It is only practicable to obtain mathematical expressions for the righting lever of stability in a few simple cases, because of the very heavy algebra involved, but these simple cases are instructive and seem worth recording.

To the already familiar example of the rectangular prism—which is directly applicable to a ship whose sections are everywhere vertical in the region of the water line—there are given below expressions for the righting lever of stability G Z for a triangular prism, both with vertex upward and with vertex down, a prism whose section below the water line at zero angle of heel is rectangular and above the water line has tumble home or flare, and, finally, a prism with a semi-circular cylinder superposed upon a rectangular prism floating at a draught greater than the depth of the rectangle. In all examples the cylinders are floating with axis horizontal, *i.e.*, without trim.

For any position of the centre of gravity, the righting lever of stability is given by the formula known as Atwood's formula, viz., using the usual notation :—

$$G Z = \frac{v \times h_1 h_2}{V} - B_o G \sin \theta.$$

It will be convenient if we assume G to coincide with the centre of buoyancy B_o for the upright position, and then—

$$G Z = B_o Z = \frac{v \times h_1 h_2}{V}$$

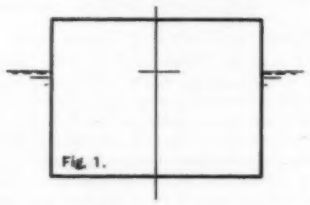
to which a correction for any other position of G can be applied.

The values of $B_o Z$ for the different prisms are as follows :—

θ is the angle of heel for constant displacement ;

M is the metacentre in the initial upright position.

(*a*) *Prism of triangular section* (the wall-sided ship)—

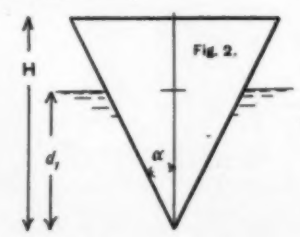


$$B_o Z = B_o M \sin \theta \left(1 + \tfrac{1}{2} \tan^2 \theta\right).$$

This expression is true for all angles of heel so long as a corner does not enter or leave the water.

If b = the breadth of the water plane in the upright position, then for any other position θ the breadth $= b \sec \theta$.

(*b*) *Prism of rectangular section of semi-vertical angle* α, *vertex down*—



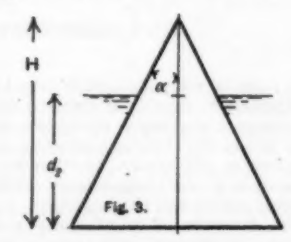
$$B_o Z = B_o M \sin \theta \left[\frac{1 + \cot^2 \alpha}{\sqrt{1 - \tan^2 \alpha \tan^2 \theta}} - \cot^2 \alpha\right]$$

The breadth of the water line so long as a corner does not enter or leave the water—

$$= \frac{b \sec \theta}{\sqrt{1 - \tan^2 \alpha \tan^2 \theta}}$$

The breadth of the water plane and therefore the moment of inertia of the water plane increases with the angle of heel more rapidly than for the rectangular prism.

(*c*) *Prism of triangular section, semi-vertical angle* α, *vertex up*—



The previous formulæ hold, whence it follows that the righting lever will be identical if $B_o M$ is the same in the two cases, and, of course, so long as G and B_o coincide.

$B_o M$ will be the same when—

$$d_1 = \frac{H - d_2}{\left\{\frac{H}{(H - d_2)^2} - 1\right\}}$$

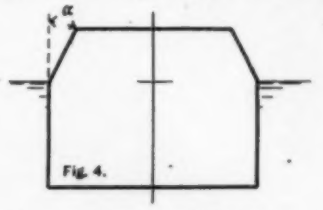
where H is the height of the section and d_1 and d_2 are the draughts of water for prisms (*b*) and (*c*) respectively.

If $d_2 = \frac{1}{2}$ H, then d_1 will $= H/6$. The righting levers will be the same, but the righting moments will be proportional to the respective displacements, *i.e.*, as d_1^2 is to $\left\{H^2 - (H - d_2)^2\right\}$, which, in the example taken, is as 1 is to 27.

The angle at which the formula for $B_o Z$ ceases to hold will be obtained by finding when a corner emerges, *i.e.*, when—

$$\frac{b}{1 + \sqrt{\frac{1 + \tan \alpha \tan \theta}{1 - \tan \alpha \tan \theta}}} = \frac{d \sin \theta}{\cos \alpha \cos (\alpha + \theta)}$$

(*d*) *Prism with rectangular section below water, the sides above water tumbling home at an angle* α.



$$B_o Z = B_o M \sin \theta \frac{2}{\left\{1 + \sqrt{1 + \tan \alpha \tan \theta}\right\}^2} \times \left\{1 + \frac{\sec^2 \theta}{\sqrt{1 + \tan \alpha \tan \theta}}\right\}$$

The breadth of the water plane at any angle θ is—

$$\frac{b \sec \theta}{\sqrt{1 + \tan \alpha \,.\, \tan \theta}}$$

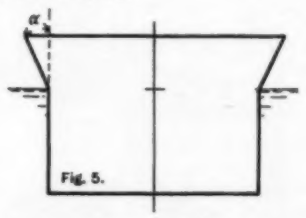
The breadth will decrease as θ increases until $\sec^2 \theta = \left\{1 + \tan \alpha \tan \theta\right\}$, when the breadth will be the initial breadth b. This will occur when $\theta = \alpha$. If θ is greater than α the breadth of the water plane will be greater than b.

If d = the depth of the rectangle, and equal to the initial draught of water, the angle θ for which the formula applies is determined from the relation—

$$d\left(1 + \sqrt{1 + \tan \alpha \tan \theta}\right) = b \tan \theta.$$

If $d = \frac{1}{2} b$, and $\tan \alpha = \cdot 5$, $\tan \theta = 9/8$.

(*e*) *Rectangular prism with sides above the water line flaring at an angle* α.



$$B_o Z = B_o M \sin \theta \frac{2}{\left\{1 + \sqrt{1 - \tan \alpha \tan \theta}\right\}^2} \times \left\{1 + \frac{\sec^2 \theta}{\sqrt{1 - \tan \alpha \tan \theta}}\right\}$$

The breadth of the water plane is $\dfrac{b \sec \theta}{\sqrt{1 - \tan \alpha \tan \theta}}$

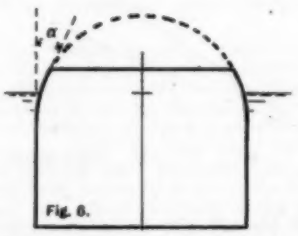
which always increases with θ so long as a corner does not enter or leave the water.

The formula for $B_o Z$ holds for angles of θ not greater than that given by—

$$d\left(1 + \sqrt{1 - \tan \alpha \tan \theta}\right) = b \tan \theta$$

If $d = \frac{1}{2} b$ and $\tan \alpha = \cdot 5$, then $\tan \theta = 7/8$, and θ is a smaller angle than for the prism with tumble home.

(*f*) *Prism with upper portion a semi-circle and the lower portion a rectangle.* The water line when the prism is upright is assumed above the centre of the semi-circle.

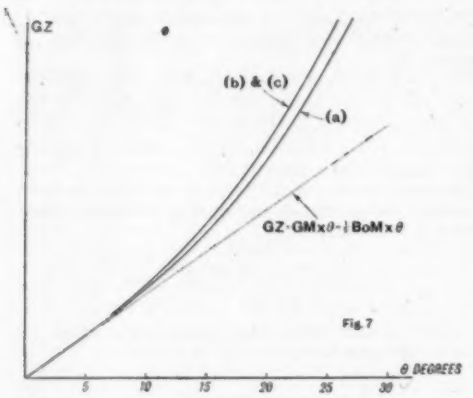


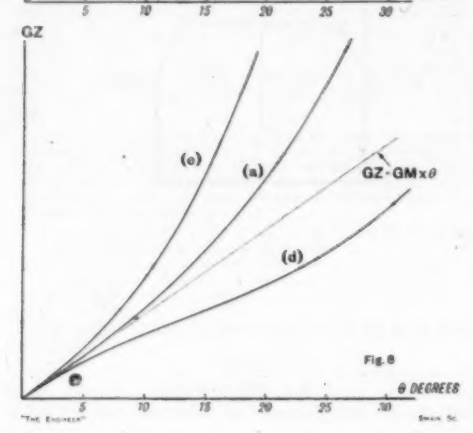
The water line now remains constant until the side of the rectangle commences to emerge, and—

$$B_o Z = B_o M \sin \theta.$$

Probably the most suitable way to compare the

characteristics of the different sections will be to compare the curves of righting lever for moderate angles of heel and for a moderate value of G M, the metacentric height. A constant metacentric height for all the forms would not be so satisfactory as a metacentric height which is a constant proportion of B_oM. In the following figures showing G Z plotted to a





base of θ, G M has been assumed to be $B_oM/5$. The ordinates of the curves multipled by B_oM will give the righting lever or the righting moment per ton of displacement.

For section (*b*) the righting moment

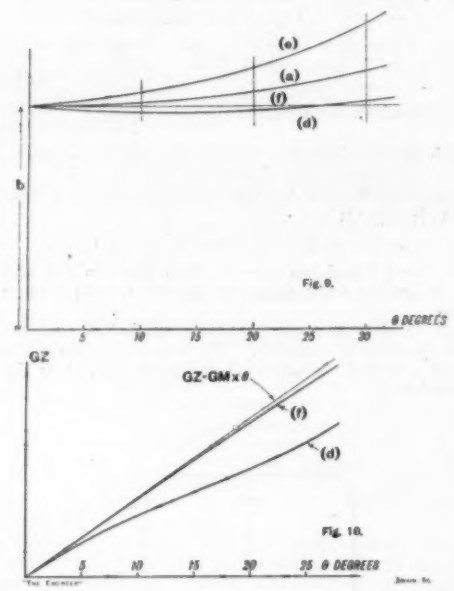
$$= W \times G Z$$
$$= W (B_oZ - B_oG \sin \theta)$$
$$= W \left\{ B_oM \sin \theta \left[\frac{1 + \cot^2 \alpha}{\sqrt{1 - \tan^2 \alpha \tan^2 \theta}} - \cot^2 \alpha \right] - B_oG \sin \theta \right\}$$

If $G M = B_oM/5$, $B_oG = 4\ B_oM/5 = 0{\cdot}8\ B_oM$, and the righting moment—

$$= W \times B_oM \sin \theta \left\{ \frac{1 + \cot^2 \alpha}{\sqrt{1 - \tan^2 \alpha \tan^2 \theta}} - \cot^2 \alpha - {\cdot}8 \right\}$$

The quantity in the brackets is plotted as curve (*b*) in Fig. 7.

Fig. 7 shows curves of G Z for the sections (*a*), (*b*) and (*c*), and for the hypothetical case when G Z



= G M × θ, where θ is in circular measure. It is to be noted that the sides of the sections are all straight, *i.e.*, of infinite radius of curvature. If the sides are symmetrically inclined for the whole depth of the ship, there is an increase in righting lever, whether the section has tumble home or flare, for all angles of heel, over the G Z for the vertically sided section provided B_oM is the same in all cases. This is due to the increase in the breadth of the water line. Fig. 8 shows similar curves for sections (*a*), (*d*) and (*e*). There is now a very marked decrease in G Z when the sides tumble home and a marked increase when there is flare above the water line.

Fig. 9 shows the rate of growth or decline of the breadth of the water planes for sections (*a*), (*d*), (*e*) and (*f*), it being assumed that, initially, each has the same breadth *b*. The sequence of the curves is the same as for the curves of G Z, $\alpha = \tan^{-1} {\cdot}5$.

Fig. 10 gives G Z curves for sections (*d*) and (*f*). In the latter the slope of the sides at the water line is the same for θ = 0 as in (*d*). But the sides gradually approach the initially vertical side for changing θ in one, but suddenly in the other.

The curves of Fig. 8 emphasise the need for great care in using the data of an inclining experiment to determine the position of the centre of gravity of a ship whose sides in the neighbourhood of the water line are changing their curvature rapidly.

New Circulating Water System at Woolwich Electricity Station.

THE Electricity Department of the Borough of Woolwich has recently carried out extensions to its generating station which comprise some interesting water circulating arrangements. The extension of the Woolwich Power Station was considered many years ago, when an attempt was made, in consultation with Sir John Snell, who is now Chief of the Electricity Commissioners, to arrange to furnish supplies in bulk to Erith and Bexley. At the time the negotiations were not successful, so that the proposed extensions were not proceeded with; but since the war, terms have been arranged between the Council and both Erith and Bexley, and at the present time the whole of Bexley and a large portion of the Erith demand are being supplied from Woolwich.

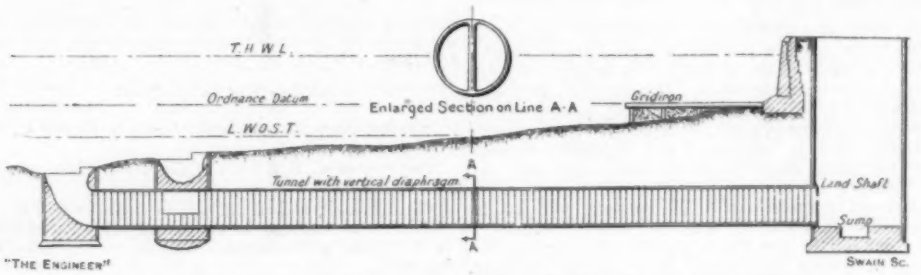


FIG. 1—DIAGRAMMATIC SECTION OF CIRCULATING WATER SHAFTS AND TUNNEL

Woolwich, it may be explained, was one of the first electrical undertakings in this country to adopt the three-phase system of working at 6600 volts, 50 cycles, which is now one of the standard systems of supply, and now it has, in addition, a 10,000-volt system, and in a few weeks, so we understand, 22,000 volts will be the pressure for the Erith supply.

This article, however, is particularly concerned, not so much with the electrical side of the undertaking, as with the method of obtaining the additional supply of circulating water for the new condensing plant. We may say at the outset that the civil engineering work in connection with this portion of the undertaking was carried out by the Foundation Company, Ltd., of London, the mechanical equipment being supplied by Glenfield and Kennedy, Ltd., of Kilmarnock. The scheme for reversal of flow was advised to be installed by Mr. J. H. Rider, of Messrs. Preece, Cardew and Rider, and the estimates were checked by Mr. Basil Mott, of Messrs. Mott, Hay and Anderson. The water is obtained from the river Thames, which is, of course, tidal where the station is erected. The method of abstraction employed is shown diagrammatically in Fig. 1. Three shafts were sunk in line, the first, which is on the river bank, is 24ft. in diameter and some 60ft. deep. Two other shafts were sunk in the river bed at about 30ft. centres by means of cofferdams. These two shafts are each 15ft. in diameter and their orifices are covered with coarse protecting grids. A horizontal tunnel, 220ft. long, with its invert 23ft. 3in. below L.W.O.S.T. and having an internal diameter of 9ft. 6in., was then driven to connect these three shafts together. The tunnel, which is composed of cast iron segments and is concrete lined, is separated into two distinct semi-circular conduits by a continuous dividing wall or diaphragm of reinforced concrete arranged vertically, and each of these conduits is connected to one of the shafts in the river bed, so as to provide an inlet and an outlet for the circulating water. The ends of the two conduits are, in the land shaft, controlled by two hydraulically operated single-face sluices, and, by means of valves arranged in the circulating water pipe work, which will be described later, it will be possible to reverse the direction of the flow of water, using first one conduit for inlet and the other as discharge, and then changing over, the object being to clear obstructions from the conduits and on the grids in the river bed. In either case the whole forms a closed system with syphonic action. The arranging of the inlet in the river bed has the advantage that only heavier solids and silt and other matters in suspension will enter the conduits; articles floating on the surface will, in all probability, not be drawn in with the water, seeing that, even at low water of spring tides, the higher grid of the two will always be submerged some 13ft. 9in. below the surface of the water. A good deal of silt, &c., will, however, evidently enter the conduits, as those who have had anything to do with the abstraction of water from tidal rivers such as the Thames will well understand, and it is therefore a very wise precaution to arrange for a reversal of flow. The capacity of each of the two conduits is about 3½ million gallons of water per

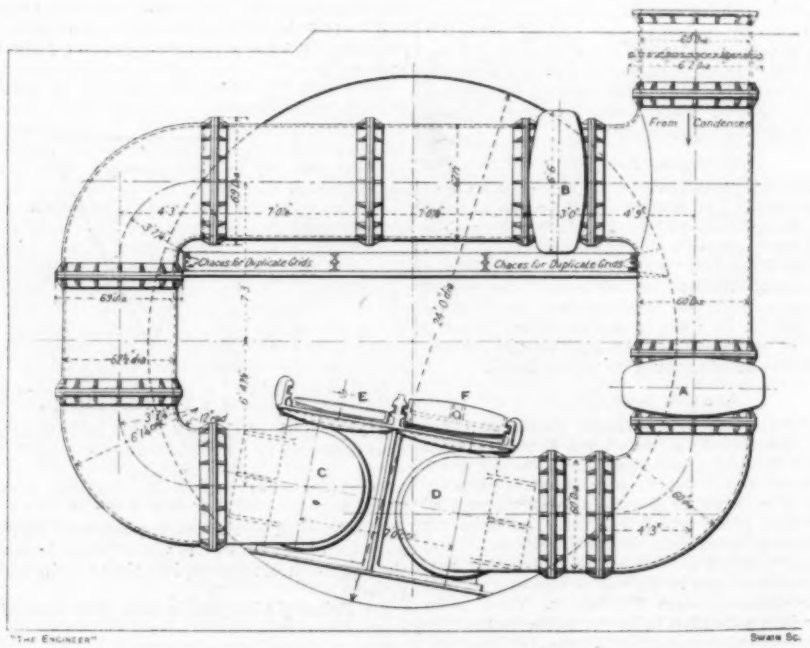


FIG. 2—ARRANGEMENT OF PIPING AT TOP OF LAND SHAFT

hour, based on a velocity of 5·3ft. per second. This quantity of water could, of course, be considerably exceeded by increasing the water velocity in the culvert.

If, as in the present case, it is proposed to use the two conduits alternately as inlet and outlet channels, it is usual, as at Woolwich, to employ a vertical dividing wall. If, however, it is intended that one of the conduits shall always act as an inlet and the other always as an outlet it is customary to have the dividing

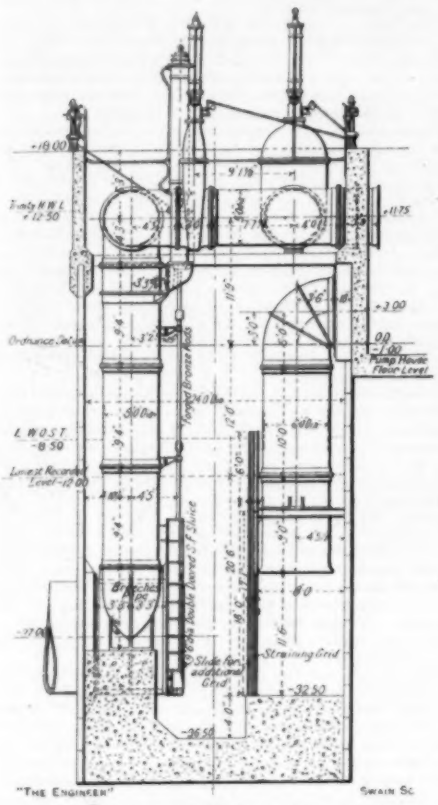


FIG. 3—VERTICAL SECTION OF LAND SHAFT

wall or diaphragm arranged horizontally. The upper conduit is then used for the discharge.

In addition to the grids over the openings in the river bed, coarse grids in duplicate are also fitted in the base of the land shaft in front of the suction chamber. Any material arrested by these grids will be removed from time to time by means of a grab operated by a crane at the surface. This crane has, however, not as yet been fixed. Furthermore,

FIG. 4—PIPING ERECTED IN MAKERS' WORKS

between the land shaft and the condenser fine rotary screens are to be erected so as to ensure that only suspended matter of small size shall be sent through the condenser tubes.

A vertical section through the land shaft is given in Fig. 3. It will be observed that the bottom is closed with mass concrete taken down to 40·50ft. below Ordnance Datum, or 39ft. 6in. below the pump-house floor level. The suction pipes, which are of cast iron, 6ft. in internal diameter and 1¼in. thick, are taken down vertically to 21ft. below Ordnance Datum; that is to say, 12ft. 6in. below low water of spring tides, and 9ft. below the lowest recorded water level. Their inlets will therefore always be deeply immersed.

A drawing showing the arrangement of the circulating water piping at the top of the well is shown in Fig. 2, while in Fig. 4 is given a view of the complete interconnecting piping as erected temporarily in the

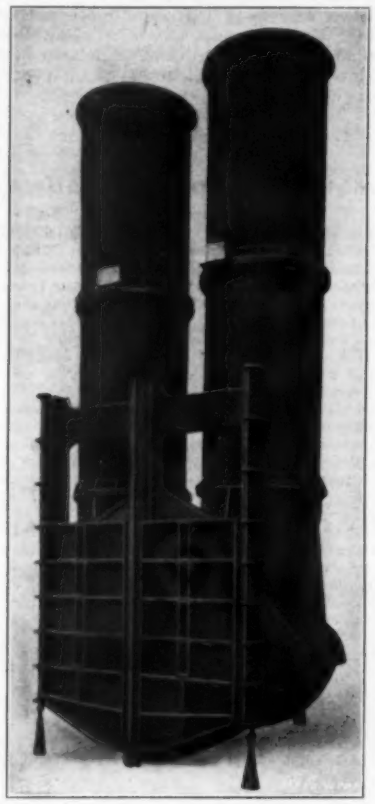


FIG. 5—UPSTAND PIPES AND SLUICES

makers' works. The water discharged from the condenser enters the system by the 5ft. diameter pipe shown at the right-hand top corner of the drawing. Then, if the valve A be closed and the valve B be open, the water flows through the latter into the pipe at the top of the drawing and passes down the pipe C to one of the conduits in the under-river tunnel. The corresponding gate at the shore end of that tunnel would at such times be closed, so that the water would pass back into the river, and the other conduit in the tunnel would serve as the inlet. Similarly, if the valve B be closed and the valve A be open, the water will flow through the latter and down the pipe D, and what was in the first case the inlet conduit in the tunnel would become the outlet, and what was at first the outlet would become the inlet. The two gates at the ends of the conduits of the tunnel are indicated in Fig. 3 by the letters E and F, but it must be understood that these gates are not in the same plane as the horizontal circulating piping, but at the bottom of the shaft with their bottoms 44ft. 3in. below the centre lines of the horizontal pipes.

The upstand pipes or vertical portions of the circulating water system are of cast iron, 5ft. in internal diameter and 1¼in. thick. At the bottom of the well they are both bolted to a cast iron breeches piece, as seen in Fig. 5, which also shows the two stop gates, both of them closed. The breeches piece casting, while undergoing machining in the makers' shops, is seen in Fig. 6. When it came from the mould it weighed very nearly 17 tons. The central vertical rib dividing it into two compartments will be observed, and it will be understood that each of these compartments communicates at one side with one of the conduits of the tunnel, the two openings at the

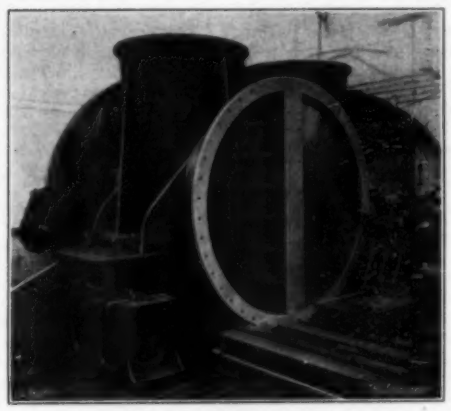


FIG. 6—BREECHES PIECE

other side being served by the two gates, already mentioned, which are, of course, operable separately. In Fig. 7 is seen the double-doored or gated sluice, as erected in the makers' works before being fixed on the site, one door being in position in its frame, the other lying on the ground in front. This double sluice is of cast iron with gun-metal faces riveted to the doors, which are machined and hand-adjusted to bear with water-tight contact on corresponding gun-metal faces which are riveted to the frame. It will be observed that all parts are heavily ribbed. The rear of the sluice frame makes a water-tight joint with a corresponding flange on the breeches piece, while the latter is spigoted into the tunnel entrance. Each sluice door or gate is operated by an independent hydraulic cylinder, each furnished with an operating or pilot

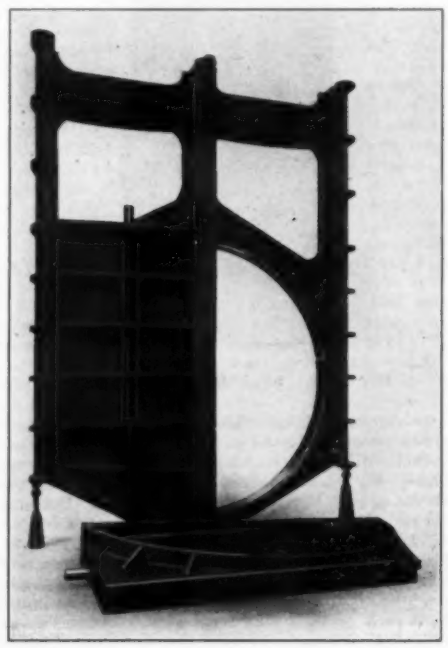


FIG. 7—9ft. 6in. DOUBLE-DOORED SLUICE GATE

valve. The working pressure, which is 220 lb. per square inch, is obtained from the boiler feed range. The cylinders are designed so that the maximum force is applied in opening the sluice doors, and there is available, so we are informed, a considerable margin of power in order to overcome any excessive resistance arising from silt, sand or other body which may have lodged in or about the sluice frame. The lifting rods are of phosphor-bronze with strong slip couplings made in halves and bolted together over recesses in the end rods. They are guided in cast iron brackets fixed to the upstand pipes, and have bronze bushes for the rubbing surfaces. The arrangement adopted was such that the whole of the upstand pipes with the sluices, rods, &c., could be set up, properly

aligned in the makers' works, where, before being taken down, the various portions were marked for re-erection purposes.

Reverting to the circulating piping at the top of the shaft, Fig. 8 shows one of the 60in. by-pass sluice valves A and B in Fig. 3. These valves are of the makers' standard four-faced type with tapered doors and bronze faces. Each is hydraulically operated by a directly superimposed cylinder, the operating pressure being 220 lb. per square inch, derived, as in the case of the double-door sluices, from the boiler feed system. All the working surfaces of these valves are lined with bronze, and the sliding spindles are of a special high-tensile forged bronze. Each valve has a tail rod projecting through a stuffing-box in the top cover of the cylinder, and the valve bodies have large cleaning doors at the bottom for the removal of any foreign matter which may accumulate. The hand holes in the casting just above the body provide ready access to the gland packings. The operating or pilot valves—one for each main valve—are fixed on cast iron standards at the operating floor level. These valves are of the four-way type, and each is provided with hand-controlled locking gear to prevent the sluice doors or sluice valve paddles, as the case may be, from closing by their own weight should the hydraulic pressure fail when they are in the open position. This locking gear is controlled by levers and links from quadrants which are under control of the attendant.

FIG. 8—60in. BY-PASS SLUICE VALVE

The whole of the piping system is designed for a working pressure of 25ft. head and was tested to a pressure of 50ft. head.

The whole scheme has been carried out under the supervision of Mr. G. W. Keats, the Borough Electrical Engineer, who was ably supported by Mr. F. F. Elliott, the Station Engineer.

The area which the Woolwich generating station at present supplies is larger than that supplied by any other municipal undertaking in London. The buildings, it may be added in conclusion, stand on a site of peculiar interest. When the Borough Council purchased the undertaking of the Woolwich District Electric Light Company in 1901, it took over the repair shops of what was originally the Woolwich Steamboat Company and later the Victoria Steamboat Association, which were then being used as the Electric Light Company's engine and boiler-house. A hand-power crane in the engine-room had, it is said, handled the remains of the Princess Alice—including the removal of her boilers—after her disastrous collision with the Bywell Castle in 1878. The new turbine and boiler-house, which form part of the present extensions, have been constructed over what was undoubtedly one of the warship building slips in use about the time of King Henry VIII. Difficulty was experienced when, some years ago, a turbine plant—which has now been superseded by a more modern type of machine—was being installed. In excavating for the foundations for the dividing wall between engine and boiler-houses, the remains of an old wooden ship were discovered. The vessel was lying in a slipway over which a graving dock had been constructed, probably about 1830, by the Waterman's Steam Packet Company. It was decided by experts that the vessel, which showed signs of destruction by fire, must certainly have been built some time in the sixteenth century. Several stone cannon balls were also found. The clearing away of the wood, &c., was a work of considerable magnitude. In all, four barge loads of oak were disposed of. The wood was a very deep black, extremely hard and most difficult to break up. Unfortunately, almost as soon as it was exposed to the atmosphere a large number of small cracks developed in it, which rendered it practically useless for commercial purposes.

A Few Observations on Railways.*

SPEAKING at a luncheon at the Birmingham Chamber of Commerce on January 6th, 1927, Sir Felix J. C. Pole said:

Individually we may hold different views whether grouping was good or bad; whether the four groups are too many or too few; whether a further step should be taken as foreshadowed in the Government White Paper to compel the railways to exchange overlapping lines, and so on. But no one can put back the clock, and what has to be done now is to leave no stone unturned to make the 1921 scheme successful.

Let me offer you a few thoughts and suggestions. The outstanding feature of the Railways Act, apart from grouping, was the constitution of a real bond of unity—of co-partnership—between the owners and users of railways. It may be difficult to realise this in the transition period during which the two parties have been engaged in prolonged proceedings before the Railway Rates Tribunal.

Remember, however, that it was not for the benefit of the railways that Parliament originally enacted a classification of goods and schedules of rates and charges. The railways could operate very well without either; all laws for regulating and controlling railways were enacted for the benefit of the community and the proceedings before the Rates Tribunal are no exception. That Tribunal has the difficult—indeed, I am tempted to say, impossible—task of deciding what charges shall be made in order to yield, with other sources of revenue, a defined return—a very modest return—on the capital invested in railway property.

But what is to be the position after the charges have been fixed? Bear in mind that the Rates Tribunal has gone far deeper into railway affairs than has ever been attempted before. The companies have been required to submit a budget of receipts and expenditure, to show how their accounts are prepared, to give the basis of depreciation and other funds, and a hundred and one other details, many of which were formerly regarded as the private business of the boards of directors. In future there will be little that is secret in railway affairs. Having settled both sides of the accounts, in due course the results of the Tribunal's work will be known, and on the "appointed day" the new classification and schedules of charges will come into operation. Cool heads will be needed if we are to get over this change with goodwill; on the railway side we intend to do our best. We do not want a repetition of the troubles of the early 'nineties, and I look to this and other Chambers of Commerce to play their part in preventing their members and the railway companies from losing their heads.

Then after a year's experience we come to the true co-partnership basis. Should the net receipts substantially exceed the amount to which the railways are entitled, and the Tribunal consider that such excess is likely to continue, rates are to be reduced by the Tribunal to the extent necessary to eliminate 80 per cent. of the surplus net receipts in future years, regardless of whether the excess has resulted from economies or increased traffic. I am sure that traders have yet to grasp this fact; when they do they will appreciate the magnitude of the change made by the Railways Act of 1921. Not only will traders have a direct interest in the financial results of the railways, but they will be able to call them to account if they are not managed economically and efficiently. I sometimes read that British railways are regarded as inefficient—by the way, that is not the opinion of foreigners, not even Americans—but substantiation of such a charge before the Rates Tribunal might have dire consequences for the company concerned.

Unfortunately, this is a one-sided clause. The railways cannot impeach the traders for the offence of contributing to inefficiency by detention of wagons, or by consigning goods in very small units, thereby making our standard wagon of 10-ton capacity compare unfavourably with the larger wagons of almost every other country in the world.

That brings me to another result of the Railways Act. All over the country there have been set up Railway and Traders' Conferences, in accordance with a scheme agreed between the Association of British Chambers of Commerce and the railways. The underlying object was the removal of friction and the promotion of mutual understanding between the railways and the public. Birmingham is the headquarters of the Birmingham, South Staffordshire, East Worcestershire and North Warwickshire Conference. I should have liked to have been able to congratulate you on the work of that Conference, but the fact is that it has done very little. This is sad, because I assure you the railways desire to make these Conferences thoroughly successful. Similar bodies have done good work in the United States and in Germany, and my own belief in them resulted in one being set up with excellent results in Khartoum between the Sudan Government Railway officials and the local Chamber of Commerce. In the case of this area I suggest that the city of Birmingham should have a Conference all to itself. It should consist of a small number of representatives on each side; there should be frequent and regular meetings and there should be determination to settle points brought forward. The minutes of the one big meeting yet held record that the chairman undertook to refer several matters to headquarters. That does not make for progress. Incidentally, however, it suggests that there may be need for a central Conference to which matters that cannot be settled locally might be referred.

Much has been heard of late about delays in transit and in discharging coal wagons. Personally, I think there are faults on both sides. It is certainly not satisfactory that privately owned coal wagons on the average should only perform 2½ journeys per month, and I shall be interested to see the results of the investigations to be carried out by the Standing Committee on Mineral Transport which the Government proposes to set up to inquire into this and kindred subjects.

Then there is the vexed question of empties. I really wish traders would send their full loads by railway and their empties by road. I wonder how long such an arrangement would last. There is scope for co-operative effort in introducing non-returnable or collapsible packing cases or the institution of common user of empties.

Another subject for discussion is one which I understand is a burning question in this district, viz., guaranteed transit of particular consignments of goods traffic. The newspapers occasionally tell us a lot about delays on the railways. I admit that we are far from perfect, but the last special record of deliveries of Great Western local traffic showed that 64·9 per cent. of the consignments were delivered the day after receipt by the company and 88·5 per cent. within two days. When traffic is interchanged with other railways the transit time is not so good, and we intend to improve. Meanwhile, I suggest that the local Conference might consider the desirability and practicability of devising a scheme whereby delivery of traffic between specific points—say, for shipment or other urgent purpose—might be guaranteed.

I might comment on the other subjects suggested for discussion by the Conference, but I must revert to my comments on the Railways Act. I suggest that another advantage secured to you by that measure is the publication of far more detailed statistics of railway operations. The Ministry of Transport is responsible for deciding what statistical data should be prepared and the basis of compilation, and I give full marks to the Ministry for what has been achieved. It is sad to reflect how little we really know of what the railways did before the war, when a ton of merchandise was recorded by each railway over which it passed as one ton, regardless of whether it was groceries or steel and whether the journey was one mile or one hundred. To-day we know that the average length of haul of all traffic carried by the railways is 53·95 miles and the average receipt per ton mile is 1·439d.

Some of you may say this is all very well, but where are the economies which were to result from grouping? The principal authors of the Railways Act—Sir Eric Geddes and Sir George Beharrel—are the persons who should tell you whether their expectations have been realised. But they have fallen from grace and have left the railways for other means of transport. If I may give my opinion, I say definitely that grouping has resulted in vast economies. That early in 1925, before the Rates Tribunal, the railway companies only claimed to have effected economies to the extent of 1½ millions has led to misapprehension. Unfortunately for the companies, but fortunately for the users of railways, under the wording of the Act, the companies could only claim an allowance in respect of the economies rendered possible by or in anticipation of amalgamation which had been effected as a result of specific steps taken since 1921. This meant that their claim was practically limited to the saving of staff rendered redundant on grouping, and claims could not be made for economies resulting from the common user of wagons or from standardisation of permanent way and rolling stock, purchase and distribution of stores, &c., many of which had been effected during the long period of Government control.

The real test of grouping economies is what would have been the *additional* cost to-day of working all the 120 lines as separate undertakings with present-day burdens. I estimate that it would have been at least £10 millions, and I claim that as a truer figure of economies resulting from grouping—and more will follow. For example, the Great Western Company took over from the absorbed companies 864 locomotives, consisting of 145 different types, a number of which were designed to burn only high-grade coal, costing about 4s. per ton more than the coal used by Great Western engines. These engines are being gradually standardised and, ultimately, there will be but two types, and a considerable saving in maintenance and fuel consumption will be effected. All this will ultimately benefit traders.

* From Great Western Information Bulletin No. 3, 1927.

BOOKS OF REFERENCE

"THE Concrete Year Book, 1927," which is published by Concrete Publications, Ltd., 20, Dartmouth-street, Westminster, S.W. 1, price 2s. 6d., appears this year in its fourth edition. The first portion of it is devoted to technical subjects, and is divided into eleven chapters having the following headings:—"Cement," "Essential Factors in Making Good Concrete," "Tables for Reinforced Concrete Design," "Water Towers," "Concrete Floors," "Granolithic Floors," "Concrete Roads," "Surface Treatment of Concrete," "Memoranda for Concrete Users," "Bibliography of Concrete and Reinforced Concrete," and "Professional Institutions and Trade Associations." Then follows a Directory Section, which gives names and addresses of (1) Consulting engineers in reinforced concrete; (2) Reinforced concrete designing specialists; (3) Contractors for concrete construction; (4) Individuals and corporations having to do with housing systems and flooring and roofing; (5) Piling contractors; (6) Concrete road contractors; (7) Dealers in aggregates and sand and asbestos-cement products; (8) Cement manufacturers; (9) Cement-making machinery manufacturers; (10) Cement testers; (11) Makers of cement-testing chemicals and apparatus, cement colouring materials, and light-weight concrete; (12) Makers of machinery and plant; (13) Purveyors of mould oil, products and cast stone, proofers and hardeners and reinforcements; (14) Periodicals; and, finally, (15) a List of trade names and brands. The last portion of the book is an illustrated catalogue section.

Obituary.

SIR WILFRID STOKES.

WIDESPREAD regret will be felt at the death of Sir Wilfrid Stokes, which took place on Monday last. Sir Wilfrid was, to the general public, possibly best known as the inventor of the Stokes gun, which played such a prominent part in the later stages of the Great War; but he was, as a fact, distinguished in many branches of engineering, and his loss will be severely felt, not only by the London and Ipswich staffs of Ransomes and Rapier, Ltd., with whom he was associated for so many years, but also by a very large circle of friends.

Frederick Wilfrid Scott Stokes was born on April 9th, 1860. He had, therefore, nearly completed his sixty-seventh year. He was the son of the late Mr. Scott Nasmyth Stokes—a barrister and a Government Inspector of Schools—and he received his early education at St. Francis Xavier's School at Liverpool, at the Kensington Catholic Public School, and at the Catholic University College, Kensington. His engineering training began when he was articled in 1878 to Mr. Lancaster Owen, M. Inst. C.E., at that time the New Works Engineer of the Great Western Railway. On the completion of his articles in 1881 he entered the service of the late Mr. William Shelford, M. Inst. C.E., with whom he remained for some four years, gaining further experience and being engaged for a portion of the time in the design of bridges and other steel work for the Hull and Barnsley Railway, including bridges over the Ouse and the Humber.

In 1885 began a connection which was to continue for the remainder of his professional life—he became assistant to the late Mr. R. C. Rapier, M. Inst. C.E., being at first employed in making designs and estimates for all kinds of lifting machines and railway plant. He held that position for eleven years, and in 1896, when the company of Ransomes and Rapier, Ltd., was constituted, he was made engineer and manager of the London office of the firm. In 1897, on the death of Mr. Rapier, he became engineer and managing director to the company. Thereafter his history and that of the company were indissolubly linked together. It is impossible to dissociate one from the other, for in everything that was done he took a part, and a great part. Yet there are certain things which can be picked out as belonging to him alone. Quite early in his association with the company Mr. Frederick Ransome, a brother of a member of the firm, applied to it in connection with rotary kilns for the burning of cement clinker. It was soon discovered that, unless the kilns were lined with an efficient refractory material, they could not be satisfactorily operated. In conjunction with the late Mr. Bertram Blount, Mr. Stokes made an exhaustive series of experiments with a view to discovering the best material to employ, and was at length successful in finding a lining, into which bauxite entered largely, that was capable of withstanding the necessarily high temperatures involved. Kilns furnished with the Stokes-Blount lining were used with excellent results in burning spent lime at the Beckton Gasworks.

Then, again, Mr. Stokes designed and patented a most useful improvement for railway breakdown cranes. By adding at each end of a breakdown crane a supplementary bogie, each bogie being temporarily connected to the main crane frame by means of a special lever and pin coupling, it was made possible to reduce the axle loads of the crane to such a degree that the crane could pass over any line or any bridge on any railway in the country. By the agency of a screw on each bogie it was possible to transfer, through the lever, a proportion of the weight of the crane to the bogies. To take one example:—A four-axle crane without the bogies might have a load of 17¼ tons on each of its four axles. In travelling order, with the bogies attached, that load might be reduced to 11¾ tons per axle, the remaining weight being transferred to the axles of the bogies. When in operation at the scene of the breakdown, saving when it was on a bridge or on a portion of the line incapable of supporting heavy axle loads, the bogies were removed.

A further introduction of Mr. Stokes was a traverser for long railway rolling stock. In the earlier days, when four and six-wheel coaches were used, a simple form of surface traverser in which there was a difference between the rail levels of traverser and railway line of 6in. to 8in., was permissible. With long bogie stock that difference of level was so great as seriously to strain and damage the bogie and its parts. With the shallow type surface traverser designed by Mr. Stokes the vertical difference in rail levels was reduced to as little as 4in., which is within the limit of tipping the bogie which is generally allowable. In cases in which it was desirable still further to reduce the tipping effect, that could be done by lowering the carriage rails under the traverser, say, an inch or an inch and a-half, and joining up the track rails by a short incline immediately under the movable ramps at the ends of the traverser. With that arrangement the rails of the traverser could be placed as little as 2in. above the normal level of the carriage tracks on which the vehicle ran when passing on and off the traverser. The tipping action was, therefore, very slight, so little, in fact, that locomotives could be taken on to the traverser without injury.

Another direction in which Mr. Stokes' activities were turned with great advantage was that of the design of sluices, in which he effected numerous improvements. He was in charge of the erection of all of the sluices on the Manchester Ship Canal and was responsible for the design of the sluices in the Asswân Dam, which structure he visited several times during the period of construction and subsequently, and for his work in connection with which he was decorated by the Khedive first of all with the Order of the Osmanieh, Second Class, and subsequently with the Order of the Medjidieh. Mr. Stokes also effected improvements in refrigerating machinery of the ammonia absorption type.

What may, however, be considered to be the outstanding feature of his life was his invention of the trench mortar—or gun, as it is more generally called—which bears his name. The history of the development of that weapon is typical of many an endeavour which was made by others of his countrymen, when it was found, soon after the war began, that, in comparison with our enemies, we were lamentably deficient in engines of warfare of various kinds. In the late autumn of the year 1914 it was represented to Mr. Stokes—as he then was—that there was an acute shortage of trench howitzers. That representation and a request that he would do what he could to devise some light but efficient weapon, which would prove more serviceable in trench warfare than anything which our armies then possessed, were made, be it said, not by the military, but by a civilian who was in a position to know with considerable accuracy exactly how matters stood. As a civilian, Stokes, a man well over the military age, fell in with the request and entered enthusiastically on a task which was to prove both arduous and expensive. His

SIR WILFRID STOKES

experiments, it may be explained, were carried out in a field adjoining the garden of his private house, at his own charges and in his leisure times at week-ends. He was working in the dark and was even ignorant of the effect of explosive charges contained within metal bodies, so that he was led to carry out experiments on metal bodies charged with explosives and buried in the ground before detonation. From those experiments he learned much. At the time he knew nothing about smokeless powders, percussion caps, fuses, cartridge cases or proper burning pressures, and so, as he himself remarked, he had much to learn; yet he undertook to do what he could, and what he did was a great deal.

His first idea was to produce some sort of a gun which would throw into the enemy's trenches a projectile having the nature of a Chinese cracker; something which, instead of entirely bursting at the outset, would produce a series of detonations and would bounce about the trench into which it was hurled very much, in fact, in the manner of the schoolboy's cracker. It was, however, to be much more deadly, as each detonation was to cause splinters of metal to fly about. His first gun was constructed of a length of solid-drawn steel tube with a 3in. bore and ¼in. thick. At its rear end it was closed with a flange, and towards its open end or muzzle a strap, to which were hinged two steel rods, splayed out to act as front legs or supports, was clipped on and secured by a screwed bolt and a fly nut. Though considerably altered in detail, the weapon finally evolved differed but little in principle from the first crude attempt. The flange was early abandoned and its place taken by a screwed-on cap which butted against a pressed steel plate let into the soil of the trench and backed with sand bags to withstand the recoil. This steel plate had three depressions in it, and when the cap closing the bottom of the tube rested in the centre depression the discharge of the gun was directly to the front. When it rested in either the left or right depression the discharge was to the right or left accordingly. The steel rods were replaced by legs fitted with a screw arrangement by which the elevation of the barrel might be adjusted. A clinometer graduated in yards, and seconds for the setting of the fuse, was also added. A periscope was fitted to some of the guns, but its use was abandoned, for it was found to be unnecessary. The flange or cap at the bottom of the barrel was furnished with an upwardly projecting spike arranged so that the percussion cap of a shell, when dropped into the barrel, might strike against it and the charge be exploded.

A great deal of ingenuity was displayed in the evolution of the projectiles for use with these guns. First of all he experimented with a cast iron shell with a black powder bursting charge and Bickford fuses to detonate in succession various chambers arranged around the circumference of the shell body, the fuses being lighted by the propellant charge. It was found difficult, however, to prevent premature bursting of the charges, so concentric chambers were tried and they proved to be entirely successful; but, for some reason or the other, they did not meet with the approval of the military authorities. Then solid-drawn steel tubes were tried, and finally a wrought steel body was adopted. It was early discovered that it was advisable to have the propellant in a separate cartridge which projected from the base of the shell, and in which holes were formed so that the propellant would burn at the requisite pressure without blowing out the end of the cartridge. In the shell finally adopted the fuse was a piece of Bickford, cut to length, and provided at the upper end with a cap for lighting it when fired and at the lower end with a detonator for exploding the high explosive charge. The cap was struck by a central bolt released by a fly-off lever similar to that of the Mills grenade, the lever being kept in position by a set-back bolt, which freed it at moment of firing. This mechanism was not, however, we believe, of Stokes' invention.

Sir Wilfrid devised three methods of adjusting the range of the gun as follows:—(*a*) Varying the charge and angle of elevation of the barrel; originally four strengths of charge were employed, but subsequently that number was reduced to two for the sake of simplicity; (*b*) providing vent holes near the base with means for opening or closing them; this plan was abandoned on account of noise, slowness of manipulation and trouble resulting from mud and water entering the trenches; and (*c*) varying the length of the striker spike so as to alter the capacity of the expansion chamber and thus vary the range. This last was also abandoned and eventually alternative (*a*) was chosen.

It is generally known how exceedingly useful the Stokes gun proved itself to be, but it is by no means so generally known how rapidly it could be fired by one skilled in its use. The method of firing was simply to insert a shell by hand, cap downwards, in the barrel and let it fall to the bottom. The bore of the gun and the diameter of the projectile were made such that a slight windage was provided for the shells so that the latter could slide freely down the barrel and yet leave time to withdraw the hand before the shot was fired. Yet even as early as before the middle of 1917 arrangements had been so perfected that thirty rounds a minute could easily be fired, while a speed of forty-three rounds in the sixty seconds had, it is said, been achieved, and as many as nine rounds from the same gun could be in the air at once. To begin with, Stokes was quite ignorant of the amount of propellant powder which would be required, and in his first experiment he used only a No. 12 sporting cartridge, which, by the way, gave the projectile a far greater range than he had anticipated and nearly caused it to hit a cottage.

For the invention and perfection of this trench mortar and its shells, and for other public works, Stokes received the honour of K.B.E. in 1917. That work was not, however, the only service which Sir Wilfrid rendered to his country in connection with the war. For example, he was Chairman of the East Anglian Munitions Committee; Chairman of the Board of Management Representation Committee; Member of the Board of Management of the Executive and Fuse Committees; Member of the Ministry of Munitions Inventions Department, sitting on four of its Committees; Member of the Officers' Resettlement Committee; Chairman of the London and Eastern Counties Association of Controlled Establishments; and President in 1918 of the Industrial Reconstruction Council. In addition, he was at one time President of the British Engineers' Association, and of the Ipswich and District Engineers Employers' Association; Chairman of the London and Eastern Counties Association of Controlled Establishments; Chairman of the Federation of British Industries, Controlled Firms Section, and Member of the Management and Organisation Committee; Chairman of the British Standard Exporter Council; Chairman of the Edgware Engineering and Aircraft Company, Ltd.; Member of the Complaints Committee under the Board of Trade Profiteering Act; Member of the Food Markets Committee; Vice-President of the Higher Production Council, &c. He was elected an Associate Member of the Institution of Civil Engineers in December, 1885, and was transferred to the class of members in December, 1902.

Sir Wilfrid, in his work, evinced a wonderful acumen and an astonishing attention to detail. He possessed an outstanding ability of "getting the hang of

things," if such an expression be permitted in a memoir of this kind. Frequently it took him but a few minutes to get to the bottom of and find a solution for problems which had up till he took them in hand proved to his colleagues to be insuperable. Moreover, he combined with great business ability a human side which endeared him to all with whom he came into contact. Even during a long and trying illness he never lost that cheerful outlook upon life which characterised him, and on his relatively rare appearances at his club his ready smile was always on his lips and a quiet quip to make light of his own ailments on the tip of his tongue. There are men that it does you good to meet, if it be no more than to pass the time of day. Sir Wilfrid was one of them. His quiet and courteous manner would sooth the ruffled nerves, whilst his happy disposition infected even those less naturally cheerful than himself. No man is universally liked, but we imagine few, placed as he was in a position where firmness was at times necessary, number so many acquaintances who regard them almost as friends as did Sir Wilfrid Stokes.

SIR JAMES KEMNAL.

THE sudden death on Tuesday last, February 8th, of Sir James Kemnal, the managing director of Babcock and Wilcox, Ltd., at the early age of sixty-three years, will be greatly lamented by a wide circle of engineers and friends, both in Great Britain and abroad, for few engineers, during the past forty years or so, have been more closely identified with the development of steam generating plant. Sir James Kemnal, or Mr. James Rosenthal, as Sir James was known in his earlier days, was born in London of British parents, his father being Mr. James Rosenthal, a naturalised British subject, and his mother of Scottish descent. He received his early education in London and studied later at Cologne University, after which period of training he was apprenticed at the works of the Belgian State Railways. On completing his apprenticeship he was appointed on the engineering staff of the Anderston Foundry Company, Ltd., Glasgow.

About this time—in 1881—the Babcock and Wilcox Company of New York established a branch office in Great Britain, the company then being represented in England by Mr. Charles A. Knight, who to-day still remains an active director of both the British and American Babcock companies. In 1883 Mr. James Rosenthal joined the British office as manager. The subsequent progress made by the company was such as to justify the formation in 1891 of a British company to carry on the business, and works were established at Renfrew. From small beginnings the Renfrew works have now been extended and to-day they occupy no less than 100 acres. With the establishment of the British undertaking in 1891 Mr. James Rosenthal became the managing director of the company conjointly with Mr. Knight, and in 1900 the business of the firm was reconstituted with increased capital under the style of Babcock and Wilcox, Ltd., with Mr. James Rosenthal as the managing director. The success of the undertaking may be gauged from the fact that the original capital of about one-quarter million pounds in 1890 reached the sum of four and a-half million pounds. In addition to the parent American and British concerns Babcock and Wilcox companies have been formed in France, Germany, Spain, and Italy, while the firm has its offices in practically every large city of importance throughout the world, and is to-day recognised as one of the largest exporters of engineering plant and materials. With the development of electrical power plant and the use of the Babcock boiler in power stations and aboard ships, both in the Navy and mercantile marine, Mr. James Rosenthal became associated with important pioneer work in these new fields. In 1920 as Mr. James Kemnal he received the honour of knighthood for the services which he and his firm had rendered to the nation during the war.

With the growth of the Babcock and Wilcox Company, Ltd., in the last seven years greatly increased duties devolved upon Sir James Kemnal, and as managing director of the board he controlled the boiler works at Renfrew, the tube works at Dumbarton, the boiler works at Oldbury—originally owned by Edwin Danks and Co., Ltd.—and the more recently acquired Clayton Boiler Works at Lincoln, which factories, together with those in Sydney, Australia, and Yokohama, Japan, give employment to over ten thousand persons. Sir James was also a director of most of the subsidiary Babcock companies in France, Germany, Spain, Italy, and Canada. In all his activities he displayed a master mind, and was happy in securing most loyal and active assistance in building up the widespread interest of the great concern which he himself was largely instrumental in creating. As a tribute to his management it may be stated that throughout the recent coal dispute the firm of Babcock and Wilcox, Ltd., was one of the few engineering undertakings which was able to continue its operations without suffering severe loss and without a material reduction of its output. Sir James Kemnal's business capacity, his outstanding ability and power of application won for him wide recognition in financial, commercial and engineering circles. Besides being a director of the companies we have already mentioned, he found time to serve on the boards of the Power Securities Corporation, Balfour, Beatty and Co., Ltd., and the Power and Traction Company (Poland), Ltd. He was also the chairman of Worthington-Simpson Ltd., of London and Newark, and was president of the British and Latin-American Chamber of Commerce. With all these commercial obligations he did not neglect the scientific and professional sides of engineering practice, and he was a valued member of the Institution of Mechanical Engineers, the Institution of Electrical Engineers, and the Institution of Naval Architects. Sir James was also a member of the Institute of Marine Engineers and he was a Fellow of the Royal Society of Edinburgh. He contributed interesting papers before several of the institutions, in which he dealt with various problems of steam generating practice. Among others, we may recall his paper of June, 1921, on "The Advantages of the Use of the Water-tube Boilers in the Mercantile Marine," which was read before the North-East Coast Institution of Engineers and Shipbuilders. In October, 1924, he addressed the members of the Institute of Marine Engineers on the subject of "Present Tendencies in Steam Generation," while in February, 1926, he gave a paper before the Institution of Engineers and Shipbuilders in Scotland on "The Development of Increased Efficiency in Steam Application for Marine Purposes." Sir James also made a notable contribution to the first World Power Conference on the subject of "Steam Generation."

His firm was early associated with the utilisation of higher boiler pressures, and one of the first of such installations which was carried out by it under the supervision of Messrs. Merz and McLellan was for the North Tees power station of the Newcastle-upon-Tyne Electric Supply Company. At this station ten boilers, working at a pressure of 500 lb., were originally installed, since which eight others have been added and are now in use. A more recent station also equipped by his firm is that belonging to the Société Anonyme Centrales Electrique des Flandres at Langerbrugge, near Ghent, which was designed for a boiler pressure of 800 lb. and a total steam temperature of 842 deg. Fah. A full description of this pioneer plant will be found in THE ENGINEER of June 4th, 1926. We have already referred to developments in land practice, but the progress made with the Babcock type of water-tube boiler at sea has been no less certain. In the Navy we may recall in passing such outstanding vessels as H.M.S. Indomitable and Renown and some ships of the "Queen Elizabeth" class, while in mercantile vessels water-tube boilers of the Babcock marine type, which were constructed under licence by Harland and Wolff, Ltd., were installed and have given excellent results in the liners Minnewaska and Minnetonka, of the Atlantic Transport Company, Ltd., and the Harland and Wolff built liners Volendam and Veendam, of the Holland-America Line.

At the spring meetings of the Institution of Naval Architects held in 1925, Sir James Kemnal warmly supported Sir Charles Parsons and Sir John Biles in their advocacy of still higher pressures for marine work. We remember his declaration that he personally would have no hesitancy in fitting boilers and steam pipes designed for a working pressure of 500 lb. per square inch in a ship of any size, and that he would guarantee the results. It now seems that such pressures will, at no distant date, actually be employed.

In both social and civil capacities Sir James Kemnal received well-deserved recognition. He was a Liveryman of the Worshipful Company of Shipwrights and a Freeman of the City of London. Only quite recently he was appointed a Justice of the Peace for the city of Glasgow, and had he lived, the honour of the LL.D. degree would have been bestowed upon him by the University of that city. Unfortunately, Sir James was taken seriously ill in September last, and during the last five months he was confined to his home at Kemnal Mount, Chislehurst, since which time he was not able to give full attention to business. Up till quite recently it was fully anticipated that he would recover and would be able to resume work at his London office. Having this purpose in view, he decided to spend some time at his seaside house, at Sandbanks, near Poole, Dorset; but at the last moment the hope of recovery was disappointed and he died somewhat suddenly on Tuesday last, and will be buried to-day at Shirley, near Croydon. His death is a loss which will be keenly felt in engineering circles and amongst a large company of business associates and personal friends.

SIR JAMES KEMNAL

HENRY WARD KEARNS.

WE have to announce with regret the death of Mr. H. W. Kearns, B.Sc., in his eighty-sixth year. Mr. Kearns was born in London and went to Manchester when a young man to be apprenticed to a firm of analytical chemists. He was afterwards engaged in the dyeing and bleaching side of the cotton industry. In 1907 he formed the company of H. W. Kearns and Co., Ltd., machine tool makers, Broadheath, near Manchester, and remained chairman of it until his death. He is succeeded in this business by his two sons, J. R. C. Kearns and H. W. L. Kearns, who have all along taken a very active part in the firm's development.

E. A. SAVAGE.

THE death of Mr. E. A. Savage, joint managing director of Buck and Hickman, Ltd., took place on Monday evening, the 7th inst. His many friends and business associates will miss his strong and cheery personality; although owing to ill-health he had lately been absent from the business with which he had been associated since he was quite a young man. Though in age only forty-eight, his high capabilities had given him a leading place in the world of commerce.

IT is stated that the Board of Trade is again to be asked to investigate the alleged rings in materials drawn upon by the shipbuilding industry. This step has been decided upon by a sub-committee of the Engineering and Shipbuilding Trades' Federation, which met in London. The high prices of materials, it was stated, were prejudically affecting the return of the shipbuilding industry to normality, though the general outlook is moderately satisfactory. The Board of Trade will receive a deputation on the matter very shortly.

Literature.

The Scientific Principles of Petroleum Technology. By Dr. LEO GURWITSCH. Translated and revised by HAROLD MOORE. London: Chapman and Hall, Ltd. Price 25s.

IT is generally conceded that the pure chemistry of petroleum, using that term in its widest sense, is one of the most complex and probably one of the least understood branches of the science. To other than an oil technologist, such a statement may come somewhat as a surprise, since the rapid evolution of modern refining and the enormous range of products now available in industry, pre-suppose a commensurate theoretical knowledge of the nature and constitution of these substances, to say nothing of the almost lavish literature extant on the practical aspects of the subject. But the fact remains, and the present author wastes no time in making his readers acquainted with the position. The separation and isolation of many of the components of petroleum oils in a chemically pure state are not only difficult, but in the majority of cases have up to the present been found impossible.

The chemistry of petroleum is not merely an intensive study of hydro-carbons as is frequently imagined. Acids, phenols, bases, sulphur compounds and other groups are equally implied, while the principles of isomerism and homology are predominent factors in each group. In particular, the number of possible and actual isomers increases with increase in molecular weight; that means that, for the higher boiling fractions obtained from petroleum, distillation as a means of separation of distinct compounds cannot be undertaken without considerable risk of decomposition. Thus, the chemical nature of the higher boiling fractions is still practically a closed book. Notwithstanding the great amount of research carried out in this connection, the way is still open for deep and prolonged investigation, but before that can go forward with real hope of adding to our knowledge, the first principles of the pure science of petroleum technology must be mastered.

Professor Gurwitsch's book has for more than a decade been a standard work of reference, especially on the Continent, even if it has not been quite so generally appreciated in English-speaking countries. That has been largely due to the lack of a suitable translation, a deficiency which unfortunately applies in the case of many excellent scientific texts published on the Continent. Not everyone is able to read German, especially technical books, with the ease and rapidity possible with his own language, and, in consequence, many volumes which might otherwise be more familiar to us remain comparatively unknown. On the other hand, a poor translation is worse than nothing at all, and it is essential that, with highly technical work, a translator should be a recognised expert in the subject dealt with by his author. In this book Mr. Harold Moore not only fills adequately the part of competent translator, but he uses his own knowledge of the subject based on a long experience to make the requisite alterations and additions by which the book is brought up to date. That is noted especially in the sections on cracking and on detonation in internal combustion engines. Thus the book has gained by its appearance in English, and both the author and translator are to be congratulated on the service thus rendered to the industry.

The plan of the work is, figuratively speaking, triangular. It unites in logical discussion the three salient features of the science—raw material, manufacture, and products. In each of these sections it is the fundamental principles and essential chemical mechanisms which receive stress; actual practice and technique, while illustrative, are subordinated. In the section on raw material the various constituents of petroleum are examined from a chemical standpoint, followed by lucid explanations of the specific gravity, viscosity, surface tension, emulsification, optical, electrical and thermal properties of oils. The section concludes with a short *résumé* of the characteristics of most important crude petroleum oils and an appendix on the origin of petroleum. In considering the crude oils of the United States, we note that Ohio-Indiana is quoted as the Mid-Continent Field. This is not correct, especially since no mention is made of the real source of Mid-Continent oil, namely, Oklahoma, Arkansas and North Texas. The omission of Rocky Mountain—Wyoming, &c.—crude oils likewise calls for comment. The appendix on the origin of petroleum is mainly a reiteration. Whilst the author may be sympathised with for leaving it at that, one could have wished for his analysis of the subject from a chemical point of view. The geologists have had it much their own way in late years, and the appearance of the chemist once again in the field would be as welcome as it would be significant. After all, no one has really quite succeeded in displacing Engler from our philosophy. Whatever shortcomings his theories may possess, they form the backbone of much brilliant subsequent work.

The second section, on manufacture, treats essentially with distillation and refining. The former process is discussed with reference to steam, vacuum, combined steam and vacuum, benzine vapour, inert gases, destructive distillation, pyrogenetic decomposition (pyrolysis, cracking), &c. In the matter of refining, although various methods have been proposed and tried, the sulphuric acid and alkali methods stand pre-eminent and are accordingly given prominence here. The section concludes with an interesting analysis of adsorption methods, based on the well-known decolourising properties of bone charcoal, Florida earth, &c. Such substances are of importance in the commercial preparation of paraffin wax, vaseline, &c., and the physico-chemical criteria involved have received much attention in recent years. In this connection Dunstan's discovery of the desulphurising properties of ignited bauxite is of interest; though its mention is relegated to a footnote here, this phenomenon is not without considerable theoretical and practical significance. We are glad to observe that the author takes note of the application of microscopy to the study of these porous substances, even to the extent of providing four photomicrographs, apart from explanatory text. In this connection more attention might have been given to the swelling properties of clay colloids as a factor in adsorption, while the function of osmosis in a theoretical discussion of the subject can hardly be ignored. "Silica gel," the hydrated form of pure silica, whose adsorptive capacity seems to be a purely physical function, is dismissed in a short paragraph, though a critical analysis of its properties would have been valuable. The author is impressed with the possibilities of Wislicenus's "sprouted" alumina made from graulated aluminium and water by catalytic action, chiefly from the fact that it furnishes a good example of the adsorptive capacity of a substance depending on inherent structure rather than chemical composition, since ordinary amorphous alumina possesses feeble decolourising properties.

Finally, the products of petroleum are considered—benzine, illuminating oils, lubricating oils, paraffin wax and vaselines. This is a comparatively short section for so large a subject, especially since the science of lubrication enters into it. Of recent years problems of lubrication have become common ground to the engineer and petroleum technologist, so much so that the study of suitable lubricants for specific purposes, in particular careful selection of appropriate grades, is no longer merely empirical or commercial, but a highly specialised branch of technical knowledge. It is certain that in future editions of this work the paragraphs on lubrication will have to be greatly expanded.

The book is replete with references to authors and widely scattered literature, but it should have included some index of the authors concerned. Without this, search for a particular paper is arduous, to say the least. The volume is clearly printed in good size type, and well produced. It is unquestionably a great asset to current literature on oil technology, and there is no doubt of its appeal to a wide circle of British and American petroleum chemists and engineers.

SHORT NOTICES.

Field Astronomy. By David Clark. London: Constable and Co., Ltd. 1926. 10s. 6d.—This excellent little book is, to a large extent, a reprint of the first two chapters of the second volume of the author's "Plane and Geodetic Surveying," and is intended to explain the principles involved in determining a position on the surface of the earth by reference to the stars. There are only three chapters in the hundred and a-half pages of the book, but they divide the subject matter admirably, into proper sections, viz., principles, instruments, and observations. In the first part the geometrical properties of a sphere are set out and such matters as the effect of the earth's motion about the sun on the apparent position of the sun are explained. Chapter II. is devoted to technical descriptions of the instruments used by surveyors. It is noteworthy, in connection with the remarks on timekeepers—one of the necessary instruments—that the author says that it is possible to detect aurally a lack of coincidence of beats as small as 0·03 sec. In the third chapter simple instructions are given for the determination of time, azimuth, latitude, and longitude.

Coal and Allied Subjects. By N. Simpkin and F. S. Sinnatt. London: H. F. and G. Witherby.—This is the second of the compendiums published by the Lancashire and Cheshire Coal Research Association and includes Bulletins Nos. XI. and XVI. inclusive. These bulletins deal with "The Stone Dusting of Mines," "The Chemical Composition of Iron Pyrites from Coal," "The Determination of Carbon Monoxide in Vitiated Air, including the Analysis of Mine Gases," "Transparent Preparations of Coal for Microscopical Investigations," "The Melting Point of Coal Ash," and "The Softening of Boiler Feed Water." The preceding bulletins of the Association have been so well received that the present collection needs no further introduction.

Business Economics. By Sir William Ashley. London: Longmans, Green and Co., Ltd. 1926. Price 2s. 6d.—In this little treatise we have a reprint of the lectures which were delivered by Sir William Ashley at the Commercial College, Copenhagen, in September last. In substance, the Copenhagen lectures follow the course given by Sir William to his students at the University of Birmingham, but, if we may put it that way, they are not in the least "scholastic," indeed we do not know where we could so readily put our hand upon a volume which would appeal so much to the general reader. The author is never didactic or dogmatic, and he aviods the dullness and triteness which are common characteristics of books on economics. He discusses many of the problems of business with which most people have now a nodding acquaintance, such questions, for example, as mass-production, obsolescence of machinery, limited liabilities, overhead charges, dumping, and so on. All these questions he handles with such plain common sense and directness that the reader not versed in the way of economics may study them with pleasure. An excellent little work for the intelligent man-in-the-train.

BOOKS RECEIVED.

Cycling Manual. Seventh edition. London: The Temple Press, Ltd., 7–15, Rosebery-avenue, E.C. 1. Price 1s. net.

The Motor Ship Reference Book for 1927. London: The Temple Press, Ltd., 7-15, Rosebery-avenue, E.C. 1. Price 5s. net.

The Practical Electricians' Pocket Book, 1927. Edited by H. T. Crewe. London: *Electricity*, 36, Maiden-lane, W.C. 2. Price 2s. 6d. net.

The Witness of the Great Pyramid. By B. Stewart. London: The Covenant Publishing Corporation, 6, Buckingham Gate, S.W. 1. Price 12s. 6d. net.

The Metallurgy of the Common Metals. Sixth edition. By L. S. Austin. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 35s. net.

History of the Sciences in Greco-Roman Antiquity. By Arnold Reymond. London: Methuen and Co., Ltd., 36, Essex-street, W.C. 2. Price 7s. 6d. net.

Journal of the Institute of Metals. Vol. XXXVI. Edited by G. Shaw Scott. London: The Institute of Metals, 36, Victoria-street, S.W. 1. Price 31s. 6d. net.

The Blue Book, 1927: *The Directory and Handbook of the Electrical Engineering and Allied Trades.* London: Ernest Benn, Ltd., 154, Fleet-street, E.C. 4. Price 25s. net.

Masonry Structures. By F. P. Spalding. Second edition revised by A. L. Hyde and E. F. Robinson. London: Chapman and Hall, Ltd., 11, Henrietta street, W.C. 2. Price 25s. net.

The Railway and Commercial Gazetteer of England, Scotland and Wales. Eighteenth edition. 1927. London: McCorquodale and Co., Ltd., Euston-square, N.W. 1. Price 21s. net.

LIVERPOOL ENGINEERING SOCIETY.

THE annual dinner of the Liverpool Engineering Society was held at the Midland Adelphi Hotel, Liverpool, on Thursday, February 3rd, and was attended by a very large and representative gathering of engineers. Mr. J. E. Lloyd Barnes, Wh.Sc., M.I. Mech. E., president, occupied the chair, and amongst the guests were the Lord Mayor, Councillor F. C. Bowring, Lieut.-General Sir Richard H. K. Butler, G.O.C. in C., Western Command, Lord Dudley Gordon, D.S.O., president of the British Cold Storage and Ice Association; Sir Joseph Cook, High Commissioner for Australia; Mr. W. Reavell, president of the Institution of Mechanical Engineers; and Sir Benjamin Longbottom, president of the Manchester Association of Engineers. In reply to the toast of "The Liverpool Engineering Society," proposed by Sir Benjamin Johnson, the president drew a humorous parallel between engineers and beavers on account of their similar propensities for building bridges and canals and for the construction of tunnels. He said the desire for thrift in regard to national and individual resources prompted the desire to do all that was possible to increase output and a supreme contempt for everything that would tend to place obstacles in the way of increased production. Sir Joseph Cook, replying to the toast of "Prosperity to the Empire," referred to the competition that was going on between the internal combustion engine, electricity and steam. Which was going to win he did not know. Referring to the new Gladstone Dock scheme, he said that Liverpool people were men of faith, and he hoped they might have the shipping to fill the docks to overflowing. Mr. W. Reavell, who was called upon at a very late hour to respond to the same toast, claimed that engineers were the most capable of appreciating it, and had done the most to make it a fact. He said that the engineer was a true Empire builder, for he bridged the rivers and tunnelled under mountains to bring undeveloped dominions into use. He irrigated the waste places of the earth and made the wilderness blossom as a rose. His brain and hand conceived and executed the romances of to-day, when continent speaks to continent and passengers and goods were conveyed through the air at incredible speeds. Jules Verne's romances were now realities, and the end was not yet, for there was no finality to engineering science. An excellent musical entertainment was provided, and a feature of it was the introduction of what is popularly termed "community singing," but there was a consensus of opinion that the toast list might with advantage have been curtailed. Seven toasts, involving about a dozen speeches—some unnecessarily long—are apt to prove a somewhat severe test of the listeners' patience.

BELFAST ASSOCIATION OF ENGINEERS.—At a meeting of the Belfast Association of Engineers, held on Wednesday evening, February 9th inst., Mr. W. E. Porter, of the Liverpool Engineering Society, read a paper on "Electrically-operated Ship's Deck Machinery," in which the design and operation of winches, windlasses and capstans was dealt with. The author discussed some of the difficulties which had to be overcome in designing machines which compared favourably in operation with similar steam auxiliaries, and some special features which had been introduced to overcome the difficulties met with were described. Referring to the performance of ship's winches, the following comparative figures, based on results obtained on steam and electrical deck machinery on two vessels in the same trade, each equipped with same number of winches working twelve hours a day for 150 days per annum, were given. The coal consumption under boilers per day worked out at 12 tons, and the oil consumption in the auxiliary Diesel engines at approximately ¾ ton. Taking coal at 30s. a ton and oil at £4 a ton, the figures showed a saving of £2250 per annum in the case of electric winches apart from further savings in maintenance costs and *personnel*. It was further pointed out that the very important questions of initial cost, interest and depreciation must be considered in any comparison of the cost of the two systems.

Work-hardening Properties of Metals.*

By EDWARD G. HERBERT.

(*Continued from page* 140.)

WORK HARDENING AS AFFECTED BY TEMPERATURE.

In 1923 work-hardening tests were first made with the pendulum hardness tester on specimens of steel at a series of rising temperatures, and the remarkable phenomenon was observed that the work-hardening capacity of the steel declined and sometimes almost disappeared at temperatures between 100 deg. and 150 deg. Cent. (212 deg. and 302 deg. Fah.). This phenomenon has been under continuous investigation since it was discovered. Its occurrence has been found to be almost universal in steels, and it has been found to occur also in many pure metals and non-ferrous alloys, usually at temperatures below 100 deg. Cent.

The test used in these determinations is not the time work-hardening test described in the second section of this paper, but the "scale work-hardening test," carried out with the same instrument in a different manner. The pendulum is placed on the specimen in a tilted position with the bubble at 0 on the scale and is released. It swings through a certain angle and stops when its energy has been absorbed in rolling out the original circular impression into an elongated form. The position of the bubble on the scale at the end of this first swing is a measure of the original scale hardness of the specimen, a harder specimen giving a longer swing and a higher reading. The pendulum is then tilted by hand to the left until the bubble is at 100 on the scale and is again released. In this case the ball rolls back along the impression which has been elongated, rolled, and work hardened, and the second reading measures the scale hardness of the surface so hardened. The process is repeated until five readings have been obtained, the first on the original surface and four on the rolled and progressively work-hardened surface. Subtracting the first reading from the average of the next four a number is obtained which is a measure of the average increase of hardness due to rolling the specimen four times, and is called the "work-hardening capacity" of the specimen. Temperature-work-hardening tests are made with the equipment shown in Fig. 20. The specimen is placed in the electric furnace and remains there during the whole series of tests, which are made at intervals of 5 deg. or 10 deg. Sixty or more tests, each consisting of five hardness measurements, can be made on a surface 1¼in. square.

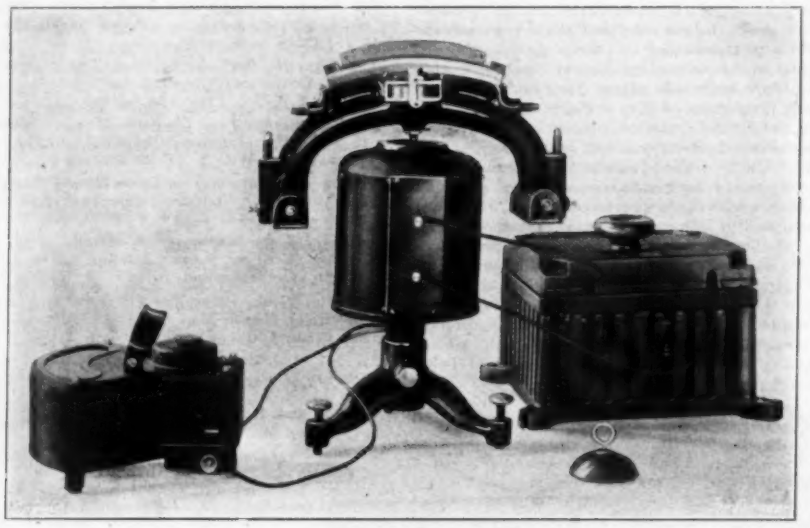


FIG. 20—PENDULUM HARDNESS TESTER AND ELECTRIC FURNACE

A typical temperature-work-hardening curve is given in Fig. 21. It is from a steel known as Vickers test bar steel, containing 0·65 carbon, 0·80 manganese, 0·3 silicon, and is interesting because this steel has been used for the test tubes on which tool steels have been tested during the past seventeen years on the Herbert tool steel testing machine. Further reference will be made to these tests in a later section. Fig. 22 is from a mild steel used by Dempster Smith for durability tests on the lathe; Fig. 23 from a very low-carbon sheet steel; Fig. 24 from a free-cutting steel; Fig. 25 from aluminium bronze; Fig. 26 from rod brass; Fig. 27 two curves from the same specimen of sheet brass, before and after annealing; Fig. 28 from an aluminium-zinc alloy; Fig. 29 from tin (the dotted curve is a repeat test on the same specimen after annealing).

In the typical curve, Fig. 21, there are six prominent features, three peaks, which are designated P1, P2, P3, and three depressions, D1, D2, D3. The principal depression D2 occurs in steels almost always at 120 deg. to 140 deg. Cent. (248 deg. to 284 deg. Fah.), though it has been found in high-speed steel at 150 deg. Cent. (302 deg. Fah.). The curves of the non-ferrous metals are so similar that there is generally no difficulty in identifying the peaks and depressions. D1 is, however, frequently absent, since D2 commences at atmospheric temperature. It is possible that D1 actually occurs below atmospheric temperature. Some probability is lent to this view by Fig. 29, in which the curve for tin was moved bodily to the right by annealing, and D1, which was previously absent, emerged.

That phenomena so striking, and common to so many metals, should have escaped the observation of metallurgists, will appear less remarkable when it is remembered that previous to 1923 the work-hardening properties of metals had not been and could not be measured at a continuous series of temperatures a few degrees apart; no appliance capable of making such measurements was in existence. The observed changes in work-hardening capacity must, however, be regarded as symptoms of some fundamental changes occurring in the structure of the metals, and it would be strange if these fundamental changes did not manifest themselves by influencing the results of physical tests other than the one described. Happily, there exists independent evidence of a striking character.

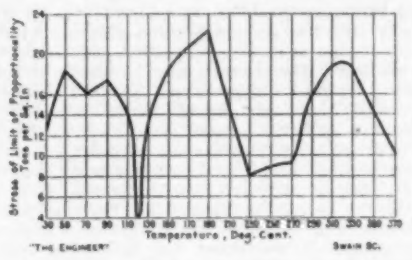
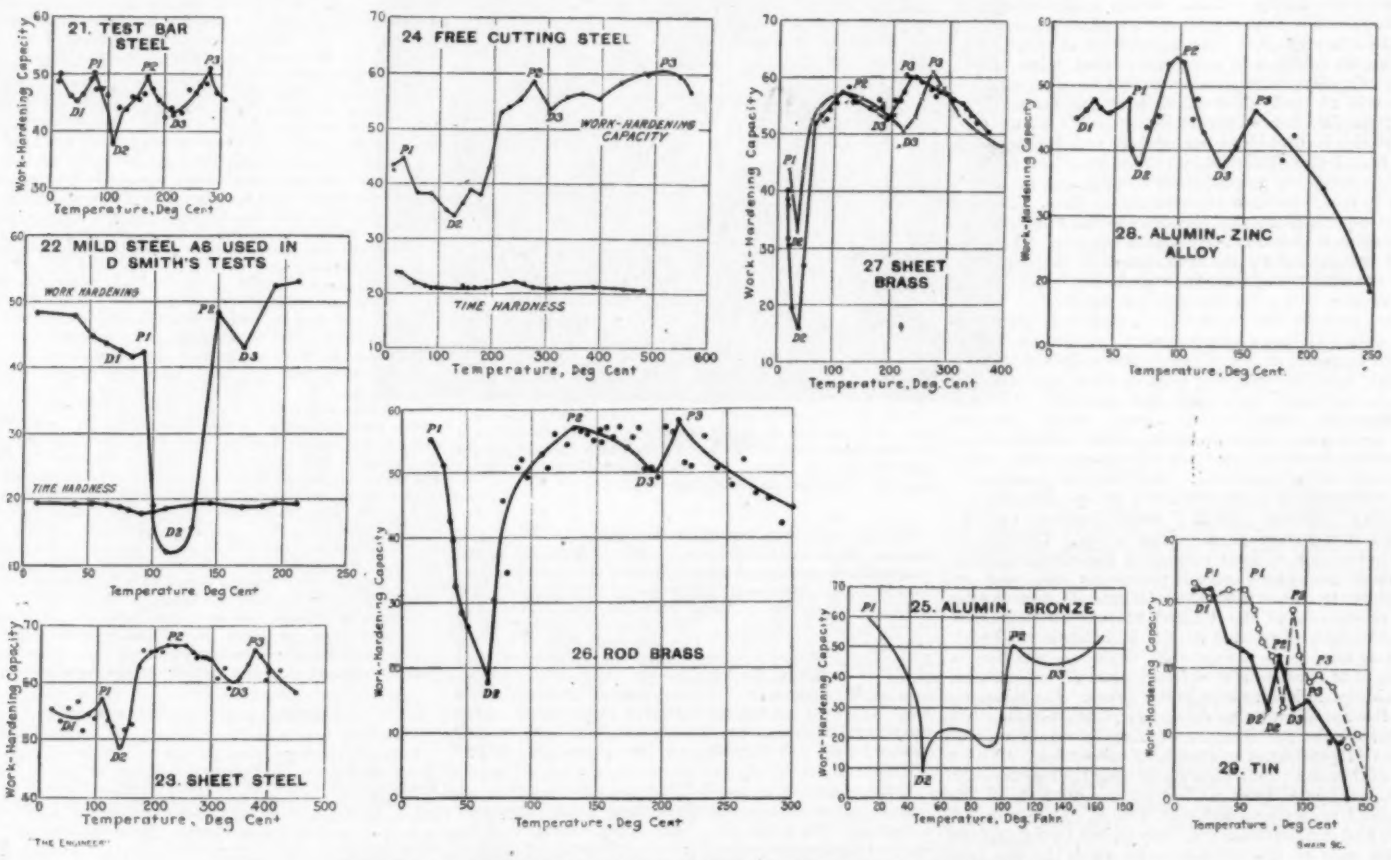


FIG. 30—LOW TEMPERATURE CHANGES IN STEEL. GOFFEY AND THOMPSON'S TORSION TESTS

In a paper on "The Changes in Iron and Steel Below 400 deg. Cent.," Goffey and Thompson collected from many sources evidence of changes in steel at low temperatures, particularly at 120 deg. Cent. (248 deg. Fah.), and described experiments of their own in which steel wires were subjected to torsion at a close succession of temperatures, and the limit of proportionality was ascertained at each temperature. One of Goffey and Thompson's diagrams is given in Fig. 30, and it is at once apparent that all the six features of the temperature-work-hardening curve, three peaks and three depressions, can be identified, the principal depression corresponding to D2 occurring at 120 deg. Such a similarity of results obtained independently by different investigators using totally different methods of investigation can scarcely be a coincidence. (Compare Figs. 28 and 30.)



FIGS. 21 TO 29—TEMPERATURE-WORK-HARDENING CURVES FOR VARIOUS METALS

The question as to which of the fundamental properties of metals undergo changes giving rise to these manifestations is one that has been the subject of much investigation. Obviously they must be properties common to the structure of the metals in which they occur, atomic, molecular, or crystalline. The evidence so far available points to some changes occurring at the crystal boundaries. It has not

* Paper presented at the annual meeting of the American Society of Mechanical Engineers, New York, December 6th to 9th, 1926.

been possible to obtain temperature-work-hardening curves from metals in a coarsely crystalline state, chiefly because the orientation of individual crystals with respect to the direction of rolling affects their work-hardening capacity and causes erratic readings.

The changes, whatever their nature, are such as to affect the flow of metals strained beyond the elastic limit. They are not known to affect the structural use of metals, but are believed to exercise a most important influence on the resistance of metals to severe deformation by cutting tools and machining operations generally.

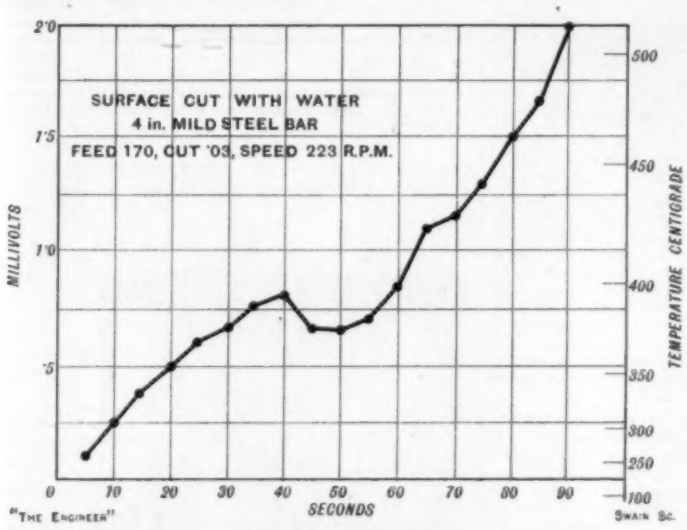


FIG. 31—VOLTAGES & TEMPERATURES GENERATED IN SURFACING MILD STEEL BAR

Work-hardening Changes and Resistance to Cutting.

It was shown in the first section of this paper that a metal cutting tool work hardens the metal before cutting it, and it was inferred that the work-hardening property of metals must be an important factor in their resistance to cutting and in their blunting effect on cutting tools. If these inferences were correct, it follows that any change in the work-hardening property must be accompanied by a change in the resistance and in the blunting effect. It has been shown in the fifth section that important changes occur in the work-hardening properties of metals as a result of changes in temperature, and in the fourth section that the range of temperatures generated in normal metal cutting comprises the range of temperatures within which the work-hardening changes occur. It remains to examine whether the observed changes in the resistance of metals to cutting, and in the durability of cutting tools, are such as would naturally result from the work-hardening changes.

FIG. 32—WHITAKER RING ON MILD STEEL BAR

FIG. 33—OUTER EDGE OF WHITAKER RING

The resistance which a metal offers to a cutting tool can be most directly measured by the vertical force on the tool while cutting. Stanton and Hyde have shown that when the cutting speed is progressively increased the vertical force on the tool declines to a minimum at a certain range of speeds, and rises at higher speeds. The decline in the vertical force was attributed to some effect of the cutting temperature on the steel operated upon. The cutting temperatures were not measured and the particular change in the work material was not identified.

Dempster Smith and Leigh made similar tests and arrived at similar results, a fall in the vertical force to a minimum at a certain range of cutting speeds. It is a fair inference from these two independent investigations that the various steels used in the experiments offered a lessened resistance to the cutting tools when they were within a certain range of cutting temperatures.

In order to test this matter further a method of investigation was suggested by Paul Whitaker. A surfacing cut was made on the end of a mild steel bar, the cut starting at the centre and ending at the periphery of the bar. Thus the cutting speed rose continuously from zero to any desired value, depending on the speed of the lathe. The vertical force on the tool was not measured, but the cutting temperature was measured by the thermo-electric method. The tool was insulated and a voltmeter was placed in circuit between the tool and the lathe. Voltage readings were taken at intervals of five seconds during the cut, and one of the resulting voltage curves is given in Fig. 31. The temperatures were ascertained by calibrating a couple made of the tool and a strip of the mild steel bar, and are given on the right of the figure. Many such tests were made, and in each case it was found that the temperature at first rose steadily with the increasing speed, then fell to a minimum, and rose to about 500 deg. Cent. (932 deg. Fah.) at the periphery of the bar.

FIG. 34—TEMPERATURE-WORK-HARDENING CURVES OF MILD STEEL BAR ILLUSTRATED IN FIG. 32

We have here clear evidence that within a certain range of speeds the generation of heat was less than at higher or lower speeds, and it is only possible to explain this on the supposition that the steel offered a lessened resistance to the tool when it was being cut within a certain range of temperatures, thus confirming the results of Stanton and Smith.

Fig. 32 is a photograph of the bar on which the surfacing cut was made, and the bright "Whitaker ring" coincides with the dip in the voltage curve. This ring is a phenomenon familiar to turners, and is certainly a temperature effect. By increasing or decreasing the lathe speed the ring can be produced at a smaller or larger diameter at will.

Fig. 33 is a photomicrograph of the outer portion of the Whitaker ring and of the adjacent surface. It shows that the ring is a smoothly finished surface contrasting with the plucked and torn surface outside it. Fig. 34 is a series of temperature-work-hardened curves made with the pendulum on a specimen of steel cut from the 4in. bar, Fig. 32. It shows the usual deep D2 depression at 135 deg. Cent. (275 deg. Fah.) where the work-hardening capacity of the steel was at a minimum. That the Whitaker ring coincides with the drop in cutting temperature was confirmed by observation and measurement. It is believed that the ring, the fall in cutting temperature, and the lessened resistance of the metal to the tool coincide with and are caused by the fall in the work-hardening capacity of the steel at the free cutting or D2 range of temperatures.

Unfortunately, it is not possible to prove this by a comparison of temperatures. The significant range of cutting temperatures, Fig. 31, is always higher than the D2 range of temperatures, Fig. 34, but this was to be expected. It was pointed out in Section 4 that the cutting temperature measured with the tool work thermo-couple is the tool temperature, and that this temperature is the highest point of a temperature gradient, rising from the temperature of the cold bar. This being so, it is certain that the D2 temperature of 135 deg. Cent. (275 deg. Fah.) occurs at some point in the zone where cutting is taking place, and where the metal is being work-hardened by compression. Any decline in the work-hardening capacity of the metal occurring in this zone must be expected to lessen the resistance to cutting.

A possible clue to a more exact location of the D2 temperature in the cut is given by microscopic examination of the cut surface in and around the Whitaker ring. Observation of these surfaces, especially in metals other than steel, has strongly suggested that the formation of the ring is accompanied by some change in the formation or in the function of the built-up edge. It has been shown that this structure normally performs a *rôle* secondary only to that of the tool. Rather it may be said that the tool merely acts as a support to the built-up edge, which is the actual cutting implement, and this is often apparent in the character of the machined surface. If it can be shown that when cutting is taking place at the D2 temperature the built-up edge ceases to function or functions abnormally, it may be possible to say with some certainty that the D2 temperature occurs at that point on the temperature gradient which coincides with the apex of the built-up edge, that is, with the precise zone where the chip becomes separated from the bar. This proof is not yet forthcoming, and there are formidable difficulties to be overcome before it will be possible to make a section through a chip in the act of being separated from a Whitaker ring. The nature of these difficulties will be sufficiently indicated by pointing out that the ring is associated with a definite temperature and that the lathe must be stopped so suddenly as to ensure that the chip left attached to the bar has been produced at that temperature.

(To be concluded.)

The Baulino Continuous Fuel Indicator.

A practical difficulty in the care and running of multi-cylinder Diesel engines, both at sea and in land installations, is to ensure that each of the individual cylinders is carrying its fair and equal share of the load. The importance of this fact is well known to all those who have charge of large powered installations, and any simple and reliable method which will assist the engineer to ensure equality of supply should be welcome.

In modern engines of large power it is generally the practice to fit a separate fuel pump to supply the fuel into each cylinder, whether compressed air or airless injection is adopted; the only well-known exception is that which is called the "common or pressure rail" system. The quantity of fuel supplied by the separate pumps is generally controlled by the timing and period of lift of the pump suction valves, and adjustments are made on the tappets of these small valves, or on the mechanism which determines the point at which a "spill valve" opens; in either case no direct knowledge or measurement of the quantity of fuel actually injected is available or possible, except under research or test-bed conditions, and the driver is only able to gauge the effect of his adjustments by indirect means, such as indicator cards, test-cocks for observing the smokiness or otherwise of the exhaust, exhaust gas pyrometers, &c.

The adjustment of the fuel pump suction valve tappets is, shortly, a matter of trial and error, and can quite readily be made in the wrong direction, and may upset existing equality of fuel quantities injected, in the endeavour to equalise other conditions whose irregularity is not due to unequal fuel quantities at all, in spite of the symptoms observed. In trials of a 2000 horse-power eight-cylinder submarine engine recently, which will be referred to later, in which the quantity of fuel to each cylinder was exactly known and controlled by the apparatus to be described, certain test cocks showed smoke, even when that cylinder was normally loaded.

In view of the development that is taking place in the use of large internal-combustion engines on land and afloat, there is thus an obvious need for some practical and simple source of information, in the light of which the engineer in charge can readily observe at any moment the amount of fuel being delivered to each or all cylinders and make adjustments accordingly and with confidence.

A solution to this problem has recently been brought out by Colonel Carlo Baulino, of the Italian Royal Naval Engineers, and it has been adopted by the Italian Navy for use on submarine engines. The apparatus contains no moving parts and depends on the application of known principles of hydro-dynamics, as will be explained later.

A small main tank A—Fig. 1—of rectangular section is kept supplied with fuel from the ready-for-service tank, and the fuel is maintained at an approximately constant level, either by means of a float-controlled valve as shown,

or in a later design by fitting a small air-cock in the closed top of the tank; this cock is normally kept closed, and the fuel level is kept sufficiently constant by the air entrapped above the level of the liquid, since that air compresses until its pressure balances the head of fuel from the service tank, in the engine-room.

From this common tank the fuel flows by difference of level into small subsidiary tanks C placed at the side of the common tank, passing through circular accurately made outlet orifices D. There are as many subsidiary small tanks as there are fuel pumps and cylinders; each pump draws its supply from a separate small tank C, and arrangements are made for any slight pump gland leakage, &c., to be piped back into its own tank C.

The orifices are all exactly equal in every respect, and the diameter is chosen having regard to the density and viscosity of the oil fuel and to the quantity that must pass per unit of time, so as to produce a fairly considerable difference of level between the common main tank and each of the subsidiary small tanks. Thus, if h is this difference of level, W is the area of the orifice, and Q the volume of liquid passing; then from the laws of hydro-dynamics we find that

$$Q = K W \sqrt{h}, \text{ or } h = \frac{Q^2}{(K W)^2}$$

where K is a constant depending upon the various magnitudes involved.

Since W is also a constant for any given size of orifice, we may write the equation as

$$h = C Q^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where C is a combined constant, and from this it is clear that the difference of level between the main and subsidiary tanks is proportional to the square of the volume of fuel delivered per unit of time; hence a very small change of the rate of flow will produce a large change of difference of level h.

Floats, or other means of indicating the levels, are fitted both to the common tank and to each small tank, and to some scale the difference of level h between the common tank A and any one of the small tanks C shows the amount of fuel actually passing to the corresponding cylinder of the engine.

Further, when the indicators on the small tanks all stand exactly at the same height, the fuel supply to all cylinders must be exactly equal; if, however, one of these levels is above or below that of the others, the delivery of the corresponding fuel pump is less or greater respectively than that of the other pumps.

Now the difference of level h, besides depending upon the rate of flow Q and upon the diameter of the orifice, is proportional to the viscosity of the fuel, hence in the interest of a convenient and open scale for h it is desirable to be able to change the set of orifices, without undue trouble, to another set of larger or smaller size as the fuel is thicker or more fluid. This is arranged for by making several sets of orifices R in axial rows in a common cylindrical sleeve T; each orifice in any one row being exactly the same as any other in the same row, but the holes in each row being progressively of larger diameter; a partial rotation of the sleeve by the lever shown changes the whole set of orifices in use to a larger or smaller set, as desired, without stopping the engine, so as to obtain the most convenient scale for h to suit the grade of fuel being used.

The use of floats carrying pointers in each tank has, in practice, certain objections, such as bulkiness and guide friction; a set of gauge glasses is preferable, one for each cylinder M and one for the main tank L; in order to avoid the clouding and dirtying of the glass by the fuel oil, these glasses are arranged to be filled with a coloured liquid. A sliding straight-edge, fitted horizontally behind the row of gauge glasses, facilitates the reading of the scales and the testing of the uniformity of the levels.

Reliability.—The only cause of failure of the apparatus that would appear possible would be the choking of the calibrated orifices by dirt in the fuel oil, and the probability of this is, of course, in inverse ratio to the size of the holes. In the Baulino indicator constructed for a 2000 horse-power eight-cylinder submarine engine, the sets of holes range from 4 mm. to 8 mm. diameter; the 5 mm. set was used for the full power readings. The relative largeness of these holes makes the probability of choking up by impurities in the fuel oil—which is almost invariably well filtered on its way to the engine—extremely remote; nevertheless, as a still further safeguard an easily operated pricking mechanism, as shown, is fitted and clears all holes simultaneously.

Sensitiveness.—A knowledge of the amount of the difference in power developed between two given cylinders, as indicated by the difference in level in the relative gauge glasses, is useful and is readily available by applying the knowledge that within reasonable limits the power remains proportional to the fuel consumption, or that

$$\text{H.P.} = A \times Q, \text{ where A is some constant.}$$

Putting this into the equation given earlier, we get

$$h = (C/A^2) \times \text{H.P.}^2, \; C/A^2 \text{ being a constant.}$$

Differentiating the equation, we have, writing B for C/A^2

$$d\,h = 2 \times B \times \text{H.P.} \times d\,(\text{H.P.})$$

and from these two equations

$$d\,(\text{H.P.}) = \tfrac{1}{2}\,\text{H.P.}\,\frac{d\,h}{h} \quad . \quad . \quad . \quad . \quad (2)$$

Taking as an example figures obtained on the submarine engine mentioned above and the tests of which will be referred to later, where H.P. = 250 per cylinder, h = 160 mm., and assuming a variation of 1 mm. in the height of the level h, which is quite readable, we get from equation (2) that d (H.P.) = 0·8 H.P.; in other words, a difference of power between cylinders of under 1 horse-power can be easily detected in 250 horse-power by the indicator.

While the indicator is in process of manufacture, two marks are put behind the main tank gauge L at a vertical distance of H apart, corresponding to a known quantity of fuel, by accurate volumetric calibration; by using these marks the total consumption per hour of the engine can be readily taken at any time, by closing the fuel supply cock to the main tank and by taking with a stopwatch the time for the fuel level to fall between the calibrated marks; a correction being then applied for temperature or specific gravity of the fuel.

This simple operation, if performed as a matter of routine regularly at intervals throughout the twenty-four hours, is a very valuable check on the performance of the engine as a whole, either at sea or in a power station.

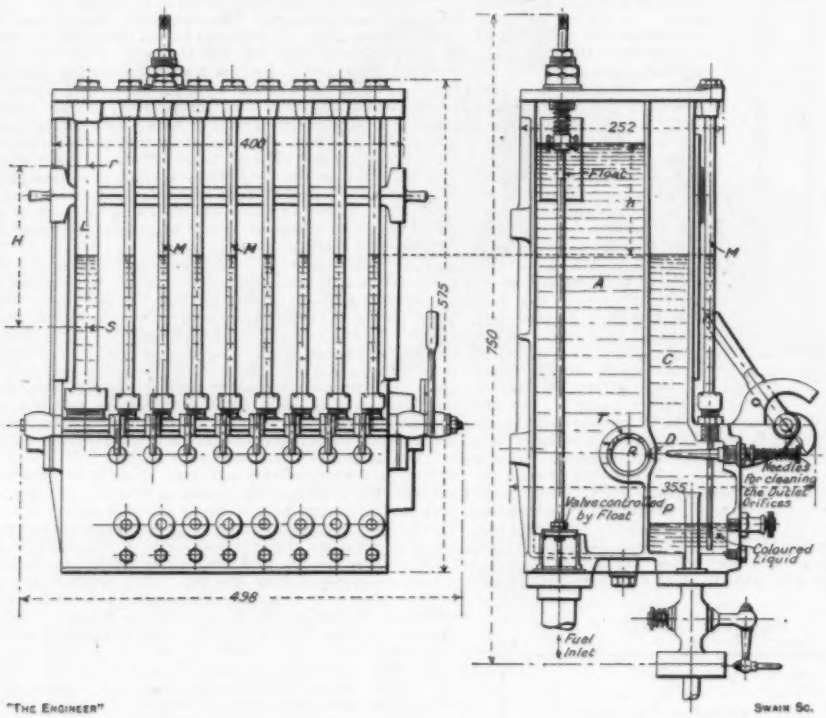


FIG. 1—ELEVATION AND SECTION OF BAULINO FUEL INDICATOR

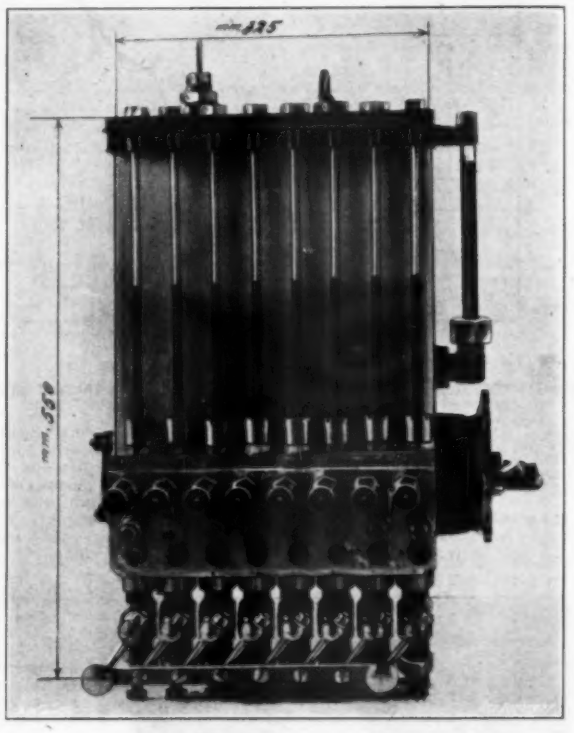


FIG. 2—FRONT VIEW OF INDICATOR

TABLE

Brake H.P.	Diameter of outlet orifice. mm	Reading of height h, mm. Cyl. No. 1.	Cyl. No. 2.	Cyl. No. 3.	Cyl. No. 4.	Cyl. No. 5.	Cyl. No. 6.	Cyl. No. 7.	Cyl. No. 8.	Mean h, mm.	Maximum variation. Of h in mm. $d\,h$.	Of power of one cylinder calculated by the formula $d\,P = \frac{1}{2} P \frac{d\,h}{h}$	Of power in one cylinder
												H.P.	Per cent.
2200	5	162	163	165	165	166	164	164	164	164	4	3·40	1·22
2005	5	142	142	144	143	145	144	146	146	144	4	3·50	1·40
1512	5	104	105	105	105	105	106	106	105	105·1	2	1·80	0·95
893	5	85	86	86	87	86	87	87	87	86·4	2	1·45	1·15
481	4	128	129	130	130	130	131	130	132	130	4	0·92	1·55
311	4	98	98	100	101	101	102	101	102	100·4	4	0·76	1·95
110	4	73	73	75	77	76	75	76	75	75	4	0·38	2·76

Practical Results.—Fig. 2 shows the Baulino Continuous Fuel Indicator as made by the Fiat Company, of Turin, and applied by it to the 2000 horse-power submarine engines that it is building for the Royal Italian Navy. The bench test of the first of these engines was carried out for twelve days, running 300 hours continuously; during this time both the Baulino indicator and the usual calibrated test-shop fuel tanks were used simultaneously for purposes of measurement and comparison. The engine developed 2200 horse-power at 400 revolutions per minute for 76 hours, the normal full load of 2000 horse-power at 380 revolutions per minute for 212 hours, and for the remainder of the time a range of smaller powers at varying speeds. At the lowest power, 80 horse-power at the lowest speed 100 revolutions per minute, the regularity of the engine was remarkable, and this result was facilitated by the adjustment of the fuel pump tappets in such a way as to maintain the whole of the eight levels in the gauge glasses at a constant and uniform height, thus ensuring that each and every cylinder was receiving the same quantity of fuel and was equally loaded.

No obstruction of the calibrated orifices was experienced throughout the long trial, and from the appended table of some of the observations made, it will be noted that the maximum deviation in power among the eight cylinders, calculated by the formula (2), was 3·4 horse-power at the highest power of 2200 horse-power, or on an average power of 275 horse-power per cylinder this amounts to 1·22 per cent.

Measurements of the total fuel consumption of the engine at this load taken by the indicator or by the shop tanks were 194 and 195 grammes per horse-power hour respectively, and *pro rata* at the other powers.

The indicator is installed close to the fuel pumps or on the control platform, and the information it gives is thus continuously under the eye of the engineer, and has been found to be unaffected by the movement of the ship in a rough sea.

At the twelfth meeting of the Electro-platers' and Depositors' Technical Society, held at the Northampton Polytechnic Institute on Wednesday, January 19th, Mr. H. Sutton, B.Sc., M.Sc. (Met.), of the Aircraft Establishment, Farnborough, read a paper on "Electro-deposited Coatings for Prevention of Corrosion." Mr. Sutton said that one of the best metals for preventing rust was zinc. A thickness of 0·0005in. gave very good protection, thicknesses exceeding it giving no materially increased protection. Cadmium deposits afforded a protection of about the same order as zinc, improved results being obtained by heating to between 200 deg. and 300 deg. Cent. Nickel was definitely inferior to zinc and cadmium, thick deposits being necessary even for moderate protection. Chromium also gave disappointing results, deposits up to 0·0025in. being ineffective. Tin and lead, though unsatisfactory preventatives of corrosion, were useful on parts which were exposed to various chemicals.

Railway Matters.

ON May 22nd, 1925, there was a collision between a light engine and a passenger train in the south tunnel at Snow Hill Station, Birmingham, as to which, as recorded herein on October the 15th following, Lieutenant-Colonel Mount reported. Now, on Thursday, January 27th, there was a similar collision at the same place.

IN this column of our issue of April 2nd last mention was made of a number of anti-friction clips, designed to facilitate the movement of switches and to avoid the necessity for oiling slide chairs, having been under trial on the Great Western Railway It is now announced by the *Great Western Railway Magazine* that 133 pairs of switches in Reading yard are to be fitted, so that experience may be gained as to their utility on a general scale.

THE dividend outlook for British railways has been made worse by the announcement that the Metropolitan, which paid 5 per cent. for the preceding two years, can only distribute 3 per cent. on the present occasion, and to do that, it must take £100,000 from reserve and carry £29,000 less forward. It is true that the good years of 1924 and 1925 had the advantage of the Wembley Exhibition traffic, but it was not expected that a drop of 2 per cent. below the 1925 dividend would be the result for last year.

THE idea, mentioned in this column in our issue of January 7th, that the London, Midland and Scottish Railway was providing water troughs in Scotland for the purpose, in part, of making record non-stop runs has now broken out afresh, and been added to by association with the trials made by that company with the Caprotti valve. It is now said that the desire is to do better than the Great Western non-stop run of 226¼ miles from Paddington to Plymouth, North-road, but if that be all that is required, it can be obtained by running from Euston to Carlisle, 299 miles, for which length there are water troughs already. The Caprotti valve is much used on the Italian State Railways, and was described and illustrated on page 674 of THE ENGINEER for December 21st, 1922.

THE report by Colonel Sir John Pringle on the collision of November 4th last between Farnborough and Fleet on the Southern Railway, when an express passenger train ran into a milk train, shows that the driver of the former—who died from injuries received in the collision—ran past the signals that were protecting the latter train. The guard of the milk train was also at fault in having failed to use the telephone, provided for the purpose, to advise the signalman at Farnborough that his train had come to a stand owing to a drawbar hook breaking. Sir John points out that the collision would also have been preventable had automatic train control been in use. He, however, concludes his report by observing that he did not think that he could usefully make any recommendations beyond drawing the attention of the company to the desirability of insisting upon proper effect being given, in similar cases of division of trains, to the instructions relating to such accidents.

THERE is a feature about the appointment, as related in our Seven-Day Journal last week, of Mr. Alexander Newlands to the position of engineer-in-chief to the London, Midland and Scottish Railway that should be an encouragement to all young railway engineers. Mr. Newlands, as we then observed, started his railway career on the Highland Railway and was with that company as an assistant on new works, as resident engineer, as assistant engineer, and then, from 1914, as chief engineer. The Highland was one of the minor secondary lines. Its situation presented many difficulties, but the opportunities for displaying engineering ability were rare and, when achieved, often failed to be known because of their remoteness. Yet, suddenly, we found Mr. Newlands in 1924 selected by Mr. Trench to be his divisional engineer at Crewe—the most important civil engineering appointment next to his own on the system—and now he succeeds Mr. Trench as engineer-in-chief to the largest and most important railway corporation in the world. Some idea of its size may be judged from the fact that the upkeep of the civil engineer's department of that company is £8,000,000 a year, and that it spent £700,000 on capital new works in 1925 and had budgeted to spend £1,140,000 last year.

IT was fifty years last Wednesday, February 9th, since the issue of the report of the 1874 Royal Commission on Railway Accidents. In THE ENGINEER of February 16th, 1877, appeared a review, over seven columns in length, of that document. Therein we observed that the report was in certain respects rather disappointing. Alluding to the fact that out of the nine members only four signed the report without reservations, two added long riders, one submitted a minority report, one—the chairman—was in India, and one neither signed nor submitted a minority report, we said that "the most unsatisfactory feature in the document is the evidence which it contains that the Commissioners were divided among themselves. . . . If this want of unanimity prevail among those who were favoured with every opportunity of obtaining information, it is proof that the subject dealt with is so complex and so vast that it is difficult to say what can be done." Our review concluded: "It is impossible to rise from a perusal of this report without coming to the conclusion that very little can be done by legislation with much hope of success. It has been shown that to extend the powers of the Board of Trade must weaken the responsibilities of the railway companies. . . . The Commissioners could not make up their minds as to the nature of the Government interference required, and, on the whole, it is tolerably evident that they think that little or nothing can be done." It is not without interest to note that THE ENGINEER was right in its anticipations. The then Government and successive Governments found that "little or nothing could be done," and it was not until 1889 that compulsory powers for the block system, interlocking of points and signals and continuous brakes for passenger trains were obtained. It is only fair to add that when that Act was passed 97 per cent. of the English and Welsh and 99 per cent. of the Scottish had the block system on their double lines and on 93·5 per cent. of the English and Welsh and 82 per cent. of the Scottish there was interlocking. The Irish figures were, however, 31 and 59 per cent. respectively.

Notes and Memoranda.

ACCORDING to Mr. T. G. Fowler, of the Cantley Beet Sugar Factory, unless the production of beets is increased by a matter of two or three tons per acre the industry will not be a success in this country. He believes, however, that such an increase can be obtained by proper methods of cultivation.

ACCORDING to the *Engineering News-Record*, the larger of the world's water reservoirs have the following capacities:—Gouin, St. Maurice River, Quebec, 160,000,000,000 cubic feet; Elephant Butte, New Mexico, 114,911,000,000 cubic feet; Assuan, Nile River, Egypt, 91,800,000,000 cubic feet; Roosevelt, Salt River, Arizona, 71,321,000,000 cubic feet; Martin Dam, Tallapoosa River, Alabama, 70,800,000,000 cubic feet. The American Falls reservoir in Idaho will have a capacity of 74,052,000,000 cubic feet when the dam has been built to its full height.

IN blasting electrically from a lighting or other circuit, the switch should, says the American Bureau of Mines, be pushed in and immediately withdrawn. Leaving the switch closed may cause an arc between two wires and set the insulation of the wires on fire. Recently, in re-blasting three missed holes in a raise with the same detonators, the miners left the switch closed for about one-half minute. The insulation on the wires of the detonator caught fire and burned up into the charges. The detonators again failed, but the burning insulation ignited the explosive in all three holes, and then detonated about twenty minutes later as men were standing under the raise.

THE possibility of recovering the enormous supplies of oil contained in the deposits of surface bitumen, oil-soaked sand, and oil shale in the United States and other countries is pointed out by the Bureau of Mines, which has devised a process with which successful extraction of oil from such material has been obtained on an experimental scale. The method, known as the Bowie-Gavin process, differs from other processes in that it can be applied to the destructive distillation of tars or very heavy oils. In most of the other processes these tars and heavy oils cannot be treated, owing to the excessive production of free carbon, which forms on the inner shell of the still and causes local overheating, or clogs the vapour lines and stops operation.

CONCERNING the electro-deposition of rubber, *Nature* says:—Against the advantages of the process must be set the fact that, since rubber is a non-conductor, it is possible to obtain only comparatively thin sheets of rubber product, though further investigation will doubtless remove this limitation. The oxygen liberated by electrolysis at the anode gives rise to a further difficulty, inasmuch as it leads to the formation of a spongy deposit; already, however, many proposals have been made for overcoming this defect, such as the use of porous moulds surrounding the anode or the addition of reducing agents to the bath. When the technique of the process has been perfected, a reduction in the cost of manufacture of sheet rubber goods and rubbered fabrics may be anticipated; not only that, but important developments may be expected in the direction of the coating of metal and other surfaces with rubber.

ACCORDING to Mr. F. A. Boyce, who recently read a paper before the Institute of Transport, in the case of the six-wheeler, if a rear tire is punctured the vehicle drops about half the amount of the section of the tire. In the case of the four-wheeler, if one of the twin tires on the rear wheels is punctured, there is no appreciable drop, as the other tire takes the weight. If these tires are fitted with a puncture alarm, which is quite reliable nowadays, the driver pulls up and there is no further damage done to either tire. In the case of the six-wheeler, however, even if the tire is fitted with an alarm, it will probably be ruined before the driver can pull up, as the full weight which the wheel has to carry is still on the deflated tire. Again, from a road damage point of view, if a six-wheeler is run continuously over a narrow secondary road, more or less in the same track, the damage to the road may be greater than that caused by a four-wheeled vehicle with twin tires.

AN example of local and relatively rapid submergence of the coast of Galveston Bay is described by Professor D. W. Johnson and Mr. W. E. Pratt in the *Geographical Journal* for January. In 1917 an oil-field was started near the mouth of Goose Creek, not far from Houston, Texas. Since then, several million barrels of oil have been taken from the field, with the result that the Gaillard peninsula, near the centre, and adjacent low coastal areas, have become submerged. In an area two miles and a half long by one mile and a half wide the maximum subsidence is now more than 3ft. The ground involved consists of recent sands and clays only slightly more compacted than sea-bottom muds, and the oil is extracted mainly from depths between 1000ft. and 4000ft. Professor Johnson is convinced that the subsidence is purely local and has nothing to do with any general sinking of the gulf coasts. Moreover, its area corresponds with the area of extraction, it is bordered by earth fractures, and it sinks steadily as extraction continues.

THE failure of an elevated sprinkling tank at Peabody, Mass., is reported in the *Factory Mutual Record*. It appears that the collapse was due to removal of several diagonal rod connections by men who were cleaning and painting the tower. The tank was a 15,000-gallon wooden tank, supported on a 65ft. steel tower. The entire structure is described as less than twenty years old and of adequate design, well maintained, and in good condition. The wind velocity at the time of the accident was not more than ten miles an hour. The collapse of the tank and tower caused large damage to nearby buildings and their contents, in addition to the total loss of the tank tower. One man was killed and a number injured. The circumstances leading up to the accident are described as follows:—"Workmen were cleaning and painting the structure. In the top section of the tower they had removed three or four of the clevises by which the diagonal rods were attached to the columns. A short time later the tank rotated 180 deg. around its vertical axis and collapsed. The cause of the collapse was undoubtedly the disconnecting of several diagonal rods."

Miscellanea.

AN aerial survey is being made of the Chittagong Hill Tract by means of two seaplanes.

THE output of gold from the mines of South Africa during 1926 was the record amount of 9,962,852 oz.

A NEW bridge is to be built across the river Danube, between Belgrade and Pancsova, at a cost of over a million sterling.

A CARGO of 500 tons of iron ore from Nastapoka Island, Hudson Bay, is being dispatched to England for testing purposes.

LEAD mines at Greenhow, Pateley Bridge, near Harrogate, which have been closed for sixty years, have been reopened, and are being worked by the Pateley Bridge Mines, Ltd.

DEPOSITS of iron have been discovered in the Arigna Mountains, Co. Leitrim, where coal mining is already carried on. A party of experts has visited the district and taken samples.

A COMMITTEE has recently been formed in Paris to raise funds for the erection of a monument to the memory of the famous French engineer, Gustave Alexandre Eiffel, the builder of the Eiffel Tower.

AS a result of alterations made recently to the Bronder retort in operation at the Australian Shale Oil Corporation's works at Latrobe, Tasmania, crude oil is, according to the *Industrial Australian*, now being produced at a cost of about 4d. per gallon.

A CONTRACT has been signed by the Lincolnshire Beet Sugar Company, Ltd., for the erection of a large sugar beet factory at Bardney, in Lincolnshire. The factory will have an initial capacity of 1000 tons per day, and will be finished in time for the 1927 crop.

PREPARATIONS are being made by the Martholme Colliery Company (Lancashire) for the reopening of Cock Pit, which has been closed since 1921. Work will be found for about 300 men, and it is understood that the company intends to build houses for the workpeople close by.

THE West Midland Joint Electricity Authority, including Wolverhampton, Walsall, West Bromwich, Shrewsbury, Cannock, Lichfield and the Midland Electric Power Corporation, has decided to expend £3,000,000 on the first stage of a scheme which will ultimately serve an area of 1095 square miles.

EXTENDED accommodation is being provided at the forthcoming Spring Show of the Royal Dublin Society at Ballsbridge for the display of farming and dairy machinery. Applications for space in the machinery and implements sections must be made on or before March 12th. A booklet has been issued by the Society.

FOUR up-to-date mills have just been laid down by the Old Castle Tin-plate Company, Ltd., and are about to be set to work. These four mills will take the place of six mills which were recently demolished. The Old Castle Works will celebrate their diamond jubilee this year, having been erected in 1867, when there were only two mills.

ACCORDING to the *British-Russian Gazette*, on January 9th a new spinning factory, the first built under Soviet auspices, and started in May, 1926, was officially opened near Undol Station, on the Moscow–Koursk Railway. The factory, which comprises 100,000 spindles and 600 machines bought in England, is the very latest model of factory technique.

ON Tuesday, February 1st, in the Chancery Division of the High Court, Mr. Justice Tomlin granted a prolongation of five years of patent No. 25,356, which is Mr. W. J. Still's original patent for a combined internal combustion and steam engine. That is the maximum period that the Court can give under the Patents Act, other than by petition of right against the Crown.

THE chimney stack at the Path-Head Colliery, New Cumnock, has, says the *Iron and Coal Trades Review*, been razed to the ground. With the shaft filled up and the boilers and machinery removed, the demolishing of the well-known landmark means practically the last stage in the dismantling operations at the pit. The rails and sleepers are all that is left of Gray's Pit, as it was formerly known.

THE Congress which it was proposed to hold during March this year, under the joint auspices of the Institution of Gas Engineers, the Coke Oven Managers' Association, and the Fuel Section of the Society of Chemical Industry, has been postponed until October, owing to the number of other important meetings that are being held during the spring. Very shortly the programme of the Congress will be issued, together with other details.

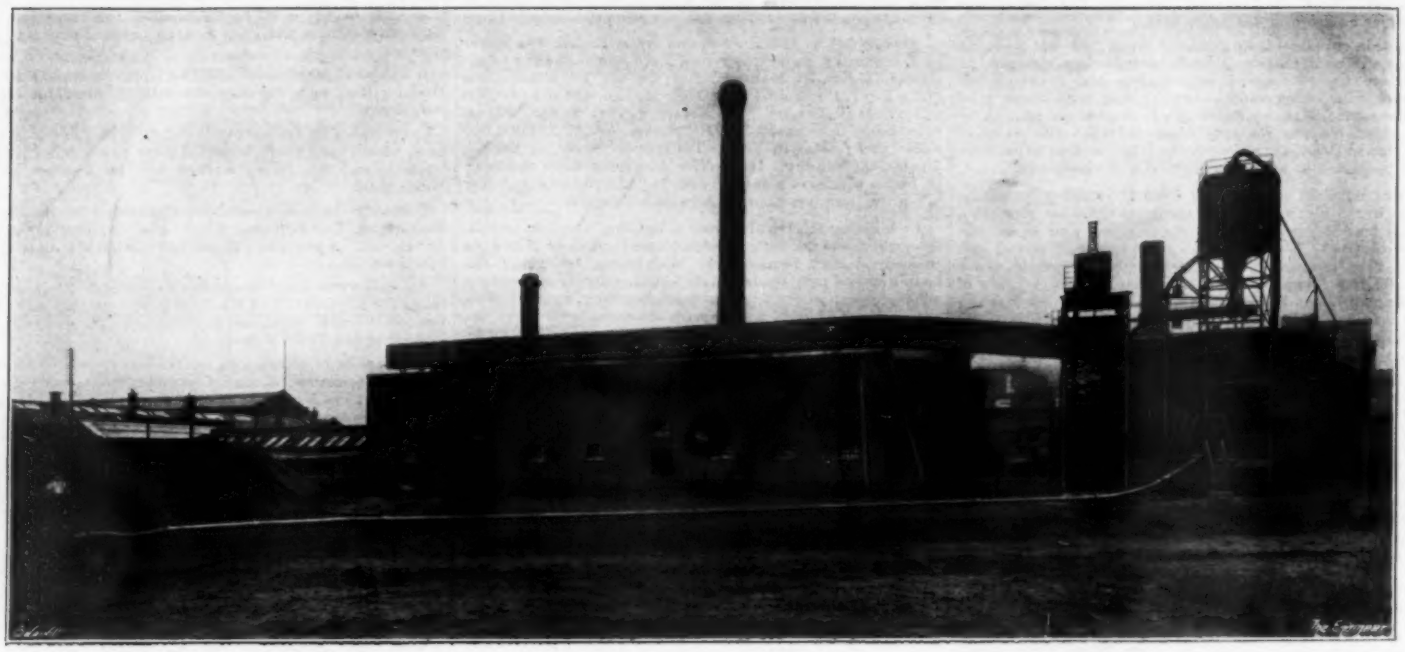
THE ex-cable ship Sherard Osborn has recently been fitted out with the necessary steam plant for the extraction of oil from the non-edible fish with which the Cape waters abound, and which at the present time, when caught, are thrown back into the sea. It is understood, says the *South African Engineer*, that, when in commission, she will act as a mother ship to two motor boats and a steam trawler which will operate the purse nets. All fish caught will be placed aboard the mother ship, and the oil contents of all non-edible fish will be recovered and while solid residue will be manufactured into fertiliser.

THE *Madras Mail* states that Messrs. Merz and McLellan, consulting engineers to the Indian Railway Board, who were asked to report on the Madras hydro-electric schemes, with special reference to railway electrification in South India, have recommended that it would be better to make a beginning in the areas immediately round about the source of power and gradually educate public opinion as to the utility and advantage of electrification. They do not recommend the extension of electrification to Madras for the time being. The Government of Madras proposes to appoint a committee of officers to tour round the area concerned and get definite agreements and undertakings from consumers of power. As soon as the committee completes its labours the Government will formulate its policy and place the facts before the Legislative Council with a view to further progress being made.

TRAFFORD PARK POWER STATION—NEW COAL-HANDLING PLANT

HENRY SIMON, LTD., MANCHESTER, ENGINEERS

(*For description see page* 163)



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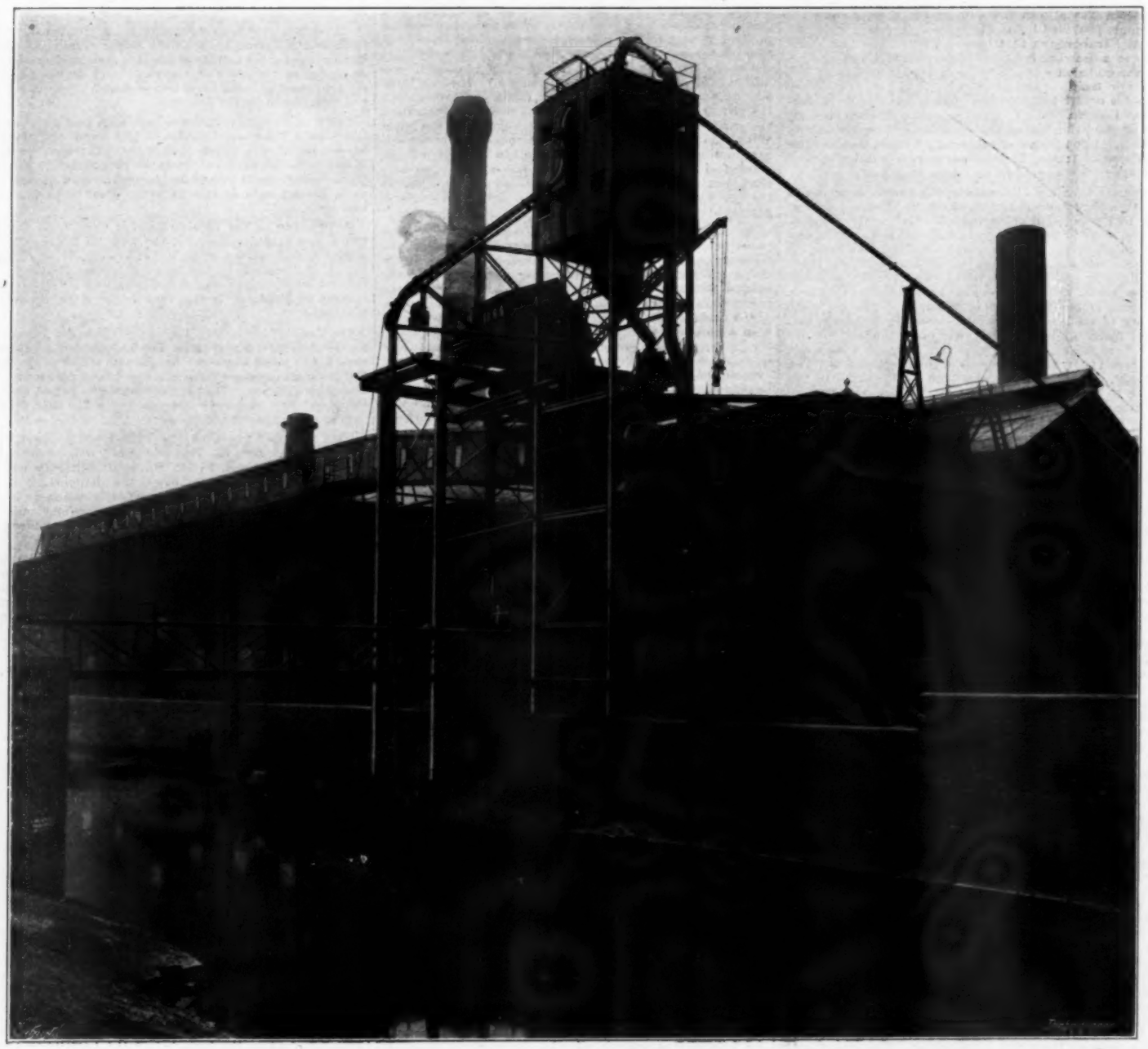

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Contents.

THE ENGINEER, February 11th, 1927. PAGE

A SEVEN-DAY JOURNAL .. 147
THE RATING AND VALUATION ACT, 1925 .. 148
THE STABILITY OF FLOATING PRISMATIC BODIES OF SIMPLE GEOMETRIC SECTION. (Illus.) .. 149
NEW CIRCULATING WATER SYSTEM AT WOOLWICH ELECTRICITY STATION. (Illus.) .. 150
A FEW OBSERVATIONS ON RAILWAYS .. 152
BOOKS OF REFERENCE .. 152
OBITUARY—
Sir Wilfrid Stokes .. 153
Sir James Kemnal .. 154
H. W. Kearns .. 154
E. A. Savage .. 154
LITERATURE .. 155
LIVERPOOL ENGINEERING SOCIETY .. 155
WORK-HARDENING PROPERTIES OF METALS. (Illus.) .. 156
THE BAULINO CONTINUOUS FUEL INDICATOR. (Illus.) .. 157
RAILWAY MATTERS .. 159
NOTES AND MEMORANDA .. 159
MISCELLANEA .. 159
LEADING ARTICLES—
The Rating of Machinery .. 161
The Burning of Low Grade Coal .. 162
SIXTY YEARS AGO .. 162
PNEUMATIC COAL AND ASH CONVEYING PLANT. (Illus.) .. 163
THE USE AND ECONOMY OF HIGH-PRESSURE STEAM PLANTS. (Illus.) .. 166
SOUTH AFRICAN ENGINEERING NOTES .. 168
PROVINCIAL LETTERS—
The Midlands and Staffordshire .. 169
Lancashire .. 169
Sheffield .. 170
North of England .. 170
Scotland .. 171
Wales and Adjoining Counties .. 171
ZINC SPECIFICATIONS .. 171
CATALOGUES .. 171
LAUNCHES AND TRIAL TRIPS .. 171
CURRENT PRICES FOR METALS AND FUELS .. 172
FRENCH ENGINEERING NOTES .. 173
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 173
FORTHCOMING ENGAGEMENTS .. 174
PERSONAL AND BUSINESS ANNOUNCEMENTS .. 174
CONTRACTS .. 174

DEATH.

January 29th, in London, E. P. DAVIS, Principal of the Bennerley Iron Company, Ltd., of Ilkeston.

THE ENGINEER.

FEBRUARY 11, 1927.

The Rating of Machinery.

FOR very many years the rating of machinery was a problem which vexed the souls of engineers. Almost annually dissatisfaction found its tongue, protests were heard, and efforts were made to get anomalies removed and to put assessment on a basis which would obviate once and for all the continually repeated struggles over details with the Assessors, and reduce the burden of taxation which manufacturing engineers believed they were unjustly called upon to bear. At length, after many years of labour, a Government was induced to do something, and in 1925 a new Rating and Valuation Act became law. Of this Act the Third Schedule is of particular interest to engineers, for it covers manufacturing machinery and plant. Now, an Act of Parliament cannot readily be perfectly explicit; or, shall we say, if it could be, it never is. The interpretation of its words has always to be decided subsequently by judges, arbitrators, umpires, and so on. In the case of rating it is the assessor who has to decide what the Act does or does not mean. His tendency is naturally to take the broadest view possible, because he will be supported by the authorities, be they of the State or municipal, who benefit by high rates Hence confusion arises and a feeling of unfair dealing is provoked. To obviate this defect the Government appointed, about a year ago, a Committee of five members, of whom two were lawyers, two engineers, and one a Fellow of the Surveyors' Institution, to set out in detail all the machinery and plant which appeared to fall within any of the classes specified in the Third Schedule to the Act. A few weeks ago this Committee made its report to the Minister of Health and presented the Statement which it had been directed to prepare.

The precise terms of this Statement are of the first moment to manufacturing engineers, for if the Statement is accepted by Parliament it will form the basis of rating assessment for years to come. In such circumstances it is of the highest importance that it should be scrutinised with the greatest care. That scrutiny has already begun. The British Engineers' Association has taken the matter up as a body and individual engineers are examining the provisions that will affect them. We may direct our readers' attention to the admirable article on the subject which Mr. F. H. Livens, of Ruston and Hornsby, Ltd., has contributed to our columns to-day. Such things, we may take it, are only the beginning. It is certain that every branch of the manufacturing engineering industry will scrutinise the precise terms of the statement with minute care and take steps, through its appropriate organisations, to protest against anything that appears to it to be inequitable. If it does not do so, it will have only itself to blame if Parliament adopts the Statement without those modifications in which it is interested. Indeed criticism is indirectly invited by the Committee, for in the introduction of its report it says:—"It may well be that in the light of observations made to him by interested parties, it will be necessary for the Minister, in pursuance of the powers conferred upon him by the Act, to modify the statement, and we wish, therefore, to make it clear that in submitting the statement we do not suggest that it is necessarily in the final form in which it should be laid before Parliament for confirmation." Continuing, it remarks upon the difficulties it has experienced in preparing the statement, points out that on several points it is possible to take more than one view of the intention of Parliament, and concludes that the true interpretation can only "be satisfactorily determined by Parliament when the statement is submitted to them, with or without modification, for confirmation." It is quite clear from these excerpts that if the statement is not actually a *ballon d'essai*, it is uncommonly like it, since the Committee having failed to reach unanimity as to the meaning of the Act, throws its statement to engineers for them to wrestle with. It has even been beaten by a small form of words. It was asked to suggest a "clearer and more definite guide than the words 'mainly or exclusively' and the words 'in the nature of a building or structure.'" It expresses its regret that it has been unable to find such a form of words. With regard to "mainly or exclusively" they, we think, must stand, to be settled by considerations which are peculiar to the case and which it is impossible to specify, but "structure" is already the subject of effective adverse criticism and will hardly succeed in justifying itself. The British Engineers' Association points out that it might be taken to include, for example, "an elevated belt conveyor supported by structural steel work." We may assume that the original intention of the term was "building or similar structure," but that form would exclude bridges, landing stages, and so on. We appreciate the difficulty experienced by the Committee. It will probably in the end be found wisest to cut out all such vague expressions and to depend upon the actual schedule of taxable things. Besides these general reservations made by the Committee as a whole there is a very important one made by the Chairman, who says:—"I am unable to concur with my colleagues in Class 6 of our statement, in that to a substantial extent items are included by us in that class which I do not think it was the intention of Parliament to include." Class 6 is a long one, including such items as Blast-furnaces, Chimneys, Conveyors and Transporters, Cupolas, Floating Docks and Pontoons, Flumes and Conduits, Gas Producers, Refuse Destructors, Silos, Towers, Weighing Machines, Windmills, and Wireless Masts. Its importance may be gathered from these few extracts from its contents. If Mr. Shortt is right, it is of the greatest importance that engineers should see that they get every benefit from the Act that it will allow. It needs but a cursory glance to see that some of these items might be classed as "structures." Is the interpretation that the Committee has put upon that word at the root of Mr. Shortt's objection to Class 6? We have already alluded to one of the criticisms made by the British Engineers' Association, but there is another, with which Mr. Livens also deals, to which attention should be directed. In the Third Schedule to the Act it is specified that machinery and plant employed for "the *primary* transformation or *main* transmission of power" is to be deemed part of the hereditament. From this form of words the statement departs and substitutes a form which in the opinion of the Association, will cause confusion and probably increase the rateable value. As an indication of the kind of bickerings that are to be expected unless the statement can be made categorical, we may say that on this point we do not see the grounds for the Association's objections, as the Committee seems to have met the objection by a subsequent paragraph; but the whole argument is too long to enter into here. It is sufficient to point out that the Association does see a difficulty in interpreting the meaning of the "form of words" used by the Committee. As Mr. Livens, also, criticises the omission of the words which we have underlined, it is plain that the words are not as precise as they should be. We trust that any

ambiguity which may exist will be removed, both here and elsewhere, before the statement is adopted by Parliament.

It would be an ideal condition if all enterprises which gave local employment were exempt from municipal taxes. It would be rational, too, for everything that encouraged the industry to thrive would benefit the municipality as a whole. But we are far from that condition, and with municipal expenditure continually outrunning its resources the tendency is ever to lay the burden on that back which seems the best able to bear it. Hence the municipal assessors search for means of bringing more and more parts of engineering plants within the scope of taxation. Against this policy engineers have to strive, not alone in their own interests, but in the interests of the municipalities in which they work, and of the whole country. They are already severely hampered by taxation which, by adding to their costs, makes competition with foreigners difficult and prevents that reduction of price which, by increasing sales, would lead to extension of business. It behoves them, therefore, to examine with thoroughness all Acts of Parliament which may increase the burdens under which they labour, or, alternatively, may offer them the means of finding some measure of relief. The Act, and particularly the Report or Statement which we have been discussing, present a case in point. Engineers are, to all intents and purposes, invited to criticise the statement of the Committee. If through any failure to do so words, passages, and items in the statement are adopted by Parliament and are subsequently found to be inimical to the interests of manufacturing engineers, they will have themselves to blame. We assume that most of them have already studied the documents with which we have dealt, but if they have not done so, we urge them to repair the omission without delay.

The Burning of Low Grade Coal.

UNTIL comparatively recently low grade coal has been regarded by engineers as something in the nature of a nuisance, appealing only to people like accountants, who know nothing about fuel but the price per ton. They regretted, like everybody else, the economic waste of leaving combustible material in the mines or lying in unsightly heaps at the pitheads; but while good coal was available at reasonable prices they had little inducement to worry themselves about the use of bad. Times, however, have changed. Coal, like everything else, has increased in price, and large consumers are being driven more and more to consider the utilisation of the poorer qualities. This, indeed, may be a blessing in disguise. By using at home coal useless for export, we not only increase our exporting capacity, but we gain a technical experience which may be turned to account. There is enormously more bad coal than good in the world, and the country which perfects the technique of using it efficiently will have a commercial advantage not to be despised. National considerations, however, are not usually in the mind of the man who has to purchase fuel. His principal motive for using low-grade fuel is that, when not hampered by excessive transport charges, it is extremely cheap, while his bitter experience of these latter months has taught him the advantage of being able to burn coke breeze, duff, colliery washings, or anything more or less related to coal. Confining ourselves to fuels of this type, which may almost be classed under the general name of colliery and gasworks refuse, they are usually excessively fine, with an inordinately high percentage of moisture and ash. The difficulty, one might even say the impossibility, of burning them on an ordinary grate, has led to alternative counter-proposals, namely, to burn them in special furnaces in a pulverised form, or to gasify them and burn the gas produced. One thing is certain, namely, that suitable plant must be provided, and the only question is, of what kind? Of recent years there has been an intensive campaign in favour of the view that the only satisfactory method of utilising low-grade fuels is in the pulverised form. Mr. W. F. Goodrich, whose opinion carries weight, expressed a strong dissent from this view in his paper on "The Utilisation of Low-grade Fuels for Steam Generation," read recently before the Institution of Fuel Economy Engineers. With any system of pulverised fuel firing, not only has the free moisture in the fuel to be much reduced, but the rock, slate and other incombustible matter, amounting perhaps to 30 per cent. or more of the whole, has to be pulverised. The capital and maintenance costs of the apparatus for these purposes is very considerable, and when to this is added the additional heavy cost of all the rest of a pulverised fuel installation, one has to examine very carefully whether the results obtained warrant the expense of the process. By the time the fuel reaches the burners, it has cost considerably more per ton than the invoice shows, and is thus handicapped economically as against simpler methods of utilisation. There is also the ash question. Something has to become of the tons of incombustible material in the fuel. As Mr. Goodrich points out, when ash is formed on a grate, at any rate one knows where it is. When it starts its life in suspension, much will be deposited on the heating surfaces, either as dust or as "bird's nests" of slag, and much, again, will float away up the chimney to the benefit, or otherwise, of the neighbourhood.

There are, of course, certain fuels such as those which are naturally dry and friable or in a finely divided state, which are specially suitable for pulverisation, and are correspondingly difficult to burn on grates. The supply of such qualities could no doubt be increased by processes of air separation at collieries, if the demand arose, though they would then have a commercial value, and consequently a commercial price. But for low-grade fuels, as they are available to-day, the system of pulverisation has yet to show that it has any all-round advantages in economy over mechanical stoking. As regards fuels with high moisture content, we could point to power stations in Canada, where lignites with moisture content varying from 20 to 40 per cent., are being burnt, year in, year out, on mechanical stokers without any preliminary drying. We could point to other stations, nearer home, where the fuel is a mixture of half and half, wet bituminous slack and coke dust. In these and all similar cases the great necessity is to have plenty of boiler capacity, or, more exactly, plenty of grate area. The Lancashire boiler, with all its merits for industrial purposes, is essentially a high-grade fuel boiler, and will have to be abandoned if really poor fuels are to be used. Its place is taken in countries without the good fuel supplies to which we have been accustomed, either by the water-tube type or more generally by a cylindrical boiler fired underneath with smoke tubes returning to an uptake in front. Such a boiler is extremely simple and cheap, its setting is particularly so, and being suspended it allows of a grate as wide as or even wider than the drum. With the shaking grates, commonly used in connection with it, the cleaning of the fires presents no difficulty, so that fuels high in ash can be burnt with reasonable comfort. There is, however, no doubt that the water-tube type of boiler is generally to be preferred, especially for modern pressures. It has all the advantages of grate area possessed by any other type, with numerous added merits of its own. With adequate draught and a modern compartment stoker, bad indeed are the fuels which cannot be burnt under a water-tube boiler, provided always that the necessary grate area is available to burn the great quantity of poor fuel required for a given amount of steam per hour. This last is the point on which so many installations fail. When burning lignite, for example, on chain grates, about a third of the grate may be covered with black coal not yet ignited, and another third with ash. In such circumstances, only a third of the nominal grate area is really covered with effective fire. Poor fuels, moreover, cannot be forced. If the draught is too strong, the lighter particles, particularly if the fuel contains coke dust, are blown unburnt up the chimney or on to the boiler tubes. The loss of such particles of valuable combustible matter by their falling through the grates into the riddlings is another of the difficulties encountered with mechanical stoking. Returning them to the hoppers in the hope that they will not fall through a second time, is but a palliative, and a troublesome one at that. Great as has been the improvement in mechanical stokers of recent years, they are still very far from perfect, and not the least of the faults which need a remedy is the loss of the fine particles of fuel.

While the battle between mechanical stoking and pulverised fuel firing still goes on, there is still another competitive system of utilising low-grade fuels which must not be lost sight of, namely, that of gasifying them. Mr. Goodrich merely mentions this method in an appreciative paragraph at the end of his long paper, referring to the work upon which Mr. T. Rowland Wollaston, of Manchester, has been engaged for several years. The method is handicapped by the inevitable losses in the producer, but if the gas can be used at its full temperature, the overall efficiency of the process may well be higher than that of burning the fuel by other means. As to the possibilities of using extremely low-grade fuel in this way, we may refer to the Dessemond installations at the collieries of St. Etienne, in France. According to a recent paper read by Monsieur Charles Berthelot before the French Society of Civil Engineers, one of these plants is gasifying 13·5 tons of washery refuse per day, containing 8 per cent. of moisture and no less than 60 per cent. of ash. This plant has been working uninterruptedly since 1921, and a larger one, to deal with 65 tons of refuse per day, was on the point of going into commission when Monsieur Berthelot's paper was written. The gas producers employed are very much like small blast-furnaces. The small one at Meons is 5 m. in height and has a cross section of half a square metre at the tuyeres. A blower capable of supplying 3000 cubic metres of air per hour under a pressure of 1500 mm. of water, and a special blast heating apparatus complete the outfit. The air heating plant is of special design, with tubes of fused quartz, and permits a temperature of blast as high as 850 deg. Cent. to be obtained at the tuyeres. With this temperature washery refuse consisting of shales, with only 15 per cent. of fixed carbon, can be treated without the addition of other fuel. Limestone is used as a flux, and it is usual to add a certain quantity of coke breeze, which enables the blast temperature to be reduced to 600 deg. Cent. From 11 tons of washery refuse, 4 tons of coke breeze and 5 tons of limestone per day, there results 35,000 cubic metres of gas, 12 tons of slag and ·75 ton of silicious iron. The gas, which has a higher calorific value of 1215 calories per cubic metres at N.T.P., is used, without enrichment for ordinary industrial operations, such as boiler firing and metallurgical furnace work. The slag, after the addition of lime, is sold as cement of good quality. A process such as this is evidently one rather for the colliery proprietors than for coal consumers to install, but it is not out of the question that certain large central stations might find gasification a means, either of using low-grade fuel as purchased from near-by collieries or of disposing of their own carbonaceous refuse. We believe, indeed, that some such scheme is under consideration by one of the most enterprising power station engineers. It affords, at any rate, and by whoever carried out, a means of utilising hitherto useless material as fuel and producing a commercially valuable cement at the same time. For this reason it is worthy of the attention of all who might profit by it.

SIXTY YEARS AGO.

IN a letter to the editor entitled "The Production of Electricity" and signed by William H. Harrison, which appeared in our issue of February 8th, 1867, particulars are to be found of an experiment which by the modern reader might almost be held to anticipate the discovery of the thermionic valve. Mr. Harrison took a hollow copper cylinder 1in. wide and 6in. deep, and closed at the bottom, and placing it in a vessel of water dropped a piece of iron rod heated to 212 deg. Fah. inside it. This tube formed what he called a central battery plate. A second plate was constituted by a sheet of copper bent round the outside of the tube, presumably without touching it. The two plates were joined by wires to a sensitive horizontal galvanometer. Mr. Harrison found that so long as the central plate maintained a temperature above that of the outer plate a weak current of electricity was registered on the galvanometer, and as the temperatures of the two plates became equal the current fell to zero. The addition of common salt to the water was found to increase the current flowing. A strange phenomenon was observed in the course of the experiment. Mr. Harrison found that when the warm copper cylinder was partially immersed in the water a weak current was given in one direction, but when the cylinder was half immersed the galvanometer needle returned to zero, while full immersion gave a stronger current than that first indicated and in the opposite direction. The experiment was repeated with equipment on a larger scale. The inner cylinder was 18in. deep and 6in. in diameter, and was charged with boiling water. The same phenomena were observed as with the original equipment, but, strange to say, the current was not more powerful than with the small apparatus. Mr. Harrison added that it was already known that when copper wire was heated a current always flowed from the hotter towards the colder portion of the wire, but he was not aware that phenomena of the kind he had described had been observed before. It would be interesting to learn whether Mr. Harrison's observations could be confirmed with modern experimental equipment and methods. It is possible that his two copper plates were not of identical chemical composition, and that his apparatus was simply a very feeble galvanic battery. On the other hand, it is possible that Mr. Harrison, although he was unaware of the fact, was studying for the first time the emission of electrons from heated metals. There are, however, features in the observations as recorded which do not seem to agree with our current knowledge of thermionic phenomena, or which, it may be, our studies of the subject have not yet revealed.

Pneumatic Coal and Ash Conveying Plant.

AN interesting exemplification of the "modernising" of an existing electric power station by the installation of a pneumatic conveying plant for dealing with both coal and ashes is that which has been effected at the Trafford Power Station, Manchester. That station was opened in 1900 to supply light and power to the factories in the Park, and started in a very modest way with two

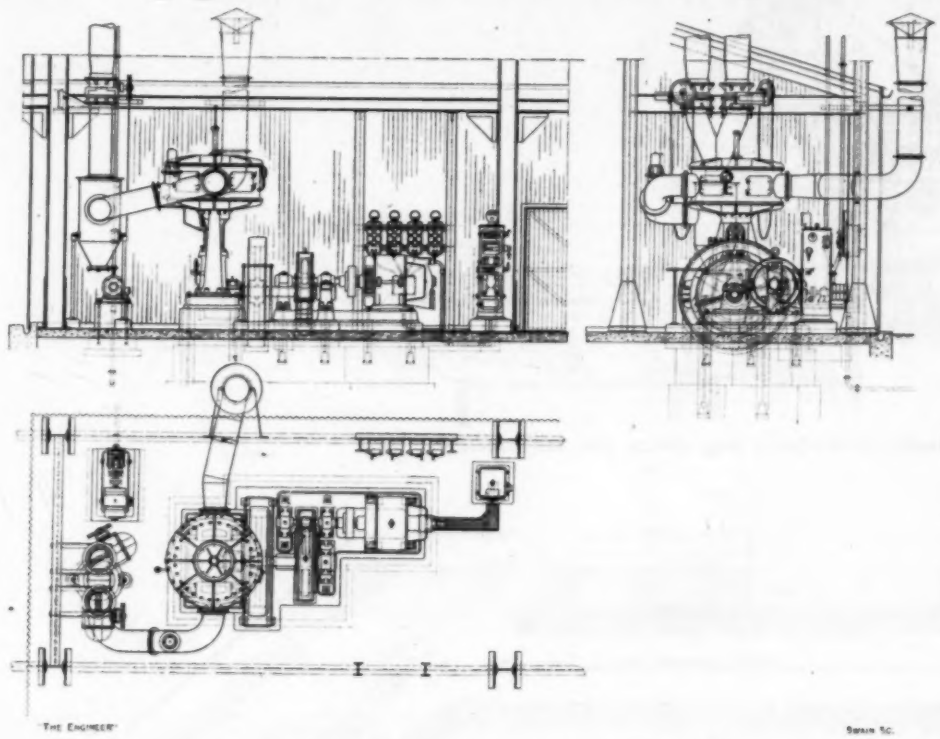


FIG. 1—VACUUM PUMP FOR COAL AND ASH-HANDLING PLANT

Brush engines and Mather and Platt dynamos, each of 500 kilowatts. Those machines were supplemented from time to time as the demand increased, until at present there are two 5000-kilowatt turbo-generator sets in addition to several more or less obsolete reciprocating engines and generators. Steam for these is supplied by ten Babcock and Wilcox boilers, the fuel for which is brought into the works by canal and rail and is dumped on land situated on the opposite side of the canal to that on which the works stand. The station, we may say in passing, is under the control of the Stretford Urban District Council, the consulting engineer being Mr. J. A. Robertson, M.I.E.E., M.I. Mech. E., and the electrical engineer Mr. T. A. Kerr, M.I.E.E.

In order to facilitate the handling of the coal as well as the removal of the ashes, it was recently decided to adopt the most modern pneumatic system in order to obviate the expense of hand labour for trucking, shovelling, &c. The work was entrusted to Henry Simon, Ltd., Manchester, and we have had opportunities of witnessing the plant in operation under normal working conditions. The new installation, which is illustrated in the two views on page 160, comprises (*a*) suction plants for discharging the coal which arrives either by barge or railway wagon and for bringing fuel from the reserve dumps; (*b*) mechanical conveyors for transferring the coal to the storage bunkers; and (*c*) a suction system to clear the ashes from the boilers. The system has, we understand, been carried further than in any other installation in the country. All the coal received is discharged pneumatically, and though the old grabs have been retained, it is not proposed to use them except in emergency. The handling of the coal has been rendered a very simple operation and considerable savings have been effected both in the time occupied in discharging consignments and also in the labour required in the process.

Though, admittedly, pneumatic plants in themselves take more power than purely mechanical plants, the advantages to be obtained from the adoption of the pneumatic system are such that in many cases, when all the factors are taken into consideration, pneumatic plants are more economical. Not only is less manual labour required, but also the time taken in discharging a barge or a wagon is reduced, because the operation is continuous. There are no "return empty" journeys as with grabs, and the suction nozzle clears the whole of the contents without requiring any shovelling or sweeping. In this way the plant works at maximum capacity at all times. Another advantage is the flexibility of the system, which enables the discharging to be carried out from awkward positions without necessitating the erection of elaborate gantries or other structures. For all intents and purposes the pneumatic plant consists of a cast iron pipe with flexible sections, which can be moved from point to point as required. In fact, the length of the conveying pipe is only limited by the power available. Coal can, moreover, be conveyed or transported over obstacles such as are often encountered in power stations; for instance, the suction pipe can be carried over a waterway, as in the present case, in which the reserve coal dumps are situated on the opposite side of the Bridgewater Canal. A further advantage is the absence of dust.

The general arrangement of the coal-handling equipment is shown clearly in the general plan, Fig. 4. The work done pneumatically includes five definite and distinct operations:—(1) the discharge of the coal from the barge; (2) the discharge from the dump; (3) the discharge from the wagon tippler hopper; (4) the discharge from the railway wagons direct; and (5) the discharge of ashes from the boilers and flues. All these operations are performed by the one vacuum pump shown in Fig. 1; but, of course, only one operation can be performed at a time. A system of change-over valves is provided so that any operation can be undertaken in a brief space of time. The arrangement of the pneumatic coal intake and the ash extraction plant is shown in Fig. 3. The capacity of the plant varies to some extent according to the particular work which it is called upon to perform and the point—in the case of the dump—at which the plant is working. A very large proportion of the coal comes by barge and the barge intake has a normal capacity of 30 tons per hour, though under specially favourable conditions that quantity, we understand, has been largely exceeded, as much as 40 tons per hour having been registered over short periods.

DISCHARGING COAL FROM BARGES.

The Bridgewater Canal runs alongside the power station and barges are brought up to the special tower carrying the pneumatic intake pipe—see Fig. 4. This pipe is plunged into the barge and the coal carried by suction to the receiver and discharged as explained later. The pipe is provided with a nozzle, specially designed for coal handling, which is curved at its lower end so that it is a simple matter to keep it well buried in the mass of coal. An auxiliary air inlet is provided at the upper end of the nozzle so that more or less air can be introduced to join the stream of coal immediately it enters the nozzle. This is a somewhat novel arrangement, as in most other types of nozzles extra air is introduced into an air box some distance up the nozzle. The extra air in this case passes down an outer sleeve and enters the main tube of the nozzle practically at the opening, and the amount admitted can be regulated by means of a valve. The whole nozzle swivels on the end of the intake pipe so as to facilitate handling.

The intake pipe is supported on a braced steel jib which swings on bearings and is carried on brackets fixed to the main members of the tower. This pipe can be slewed through a complete half circle by means of hand ropes operated from the towpath, and the vertical portion has a telescopic section which admits of a variation in height up to a maximum of 10ft. to allow for the rise of the barge as it is lightened. The bend at the top of the vertical section is fitted with a renewable plate formed of heavy cast iron section. A self-sustaining winch, carried on a seating at the end of the jib, operates the telescopic movement and is controlled from the barge or towpath by means of an endless chain. Above the bend the pipe is carried up at an angle of 40 deg. to the top of the tower where it enters the receiver. A cut-off valve is fitted just before the receiver so that the barge discharging section can be disconnected if desired. This valve is operated from the tipper room by means of a hand wheel.

The coal is delivered from the receiver through a mechanically-operated tipping seal and passes to a sheet steel hopper arranged immediately above a 5-cwt. "Avery" automatic weigher. This hopper is fitted with an automatic dribble feed, and as soon as the weigher has received its full capacity the feed gate is closed and the contents are delivered to the receiving hopper below the weigh room.

MECHANICAL CONVEYORS.

The coal next passes by gravity to a swivelling feed-on shoe attached to a band conveyor arranged to feed either direct to a bunker immediately below this conveyor and above No. 2 boiler-house, or to another conveyor feeding the new bunkers above No. 1 boiler-house, as shown in the plan Fig. 5. This short band conveyor is pivoted near the feed end and is carried on a trunnion bearing supported from the main uprights of the tower, an arrangement which allows the conveyor to be swung round through a wide angle so that the coal can be distributed over a considerable area of the bunker. A plough is also provided at a point midway between the feed and the delivery ends of the conveyor so that the coal can be thrown off at that point, if desired, in order to distribute the coal evenly over the whole bunker. This plough can be swung clear of the belt when it is not in use. The belt is 16in. wide and is carried on rollers at a speed of approximately 300ft. per minute.

The conveyor is electrically driven by an independent electric motor through spur gearing and is controlled from the main pump house. If it is desired to feed to the series of new bunkers over No. 1 boiler-house, the swivelling conveyor is swung round and delivery is made to the head end of another conveyor running the whole length of the line of new bunkers. This conveyor is 210ft. long and is provided with a 16in. belt running in troughing rollers. The conveyor frame consists of channel iron sections supported from the floor of the gantry by means of angle irons. These channels act as a rail track for the self-traversing throw-off carriage, which is so arranged that delivery can be made to any of the bunkers feeding the eight boilers. The bunkers have a capacity of 600 tons and were included in Messrs. Simon's contract.

THE NEW BUNKERS.

The new bunkers are constructed of steel plates varying in thickness from ⅜in. at the top of the bunker to ½in. at the lower end. They are carried on braced steel stanchions mounted on mass concrete foundations. These stanchions are arranged at varying centres so as to clear the stokers when they are drawn out and also to clear existing condenser water culverts below the boiler-house floor. The bottom of the bunker is inclined so that the coal will flow down to the outlets. There are sixteen of these outlets and each is provided with a slide valve operated by chain

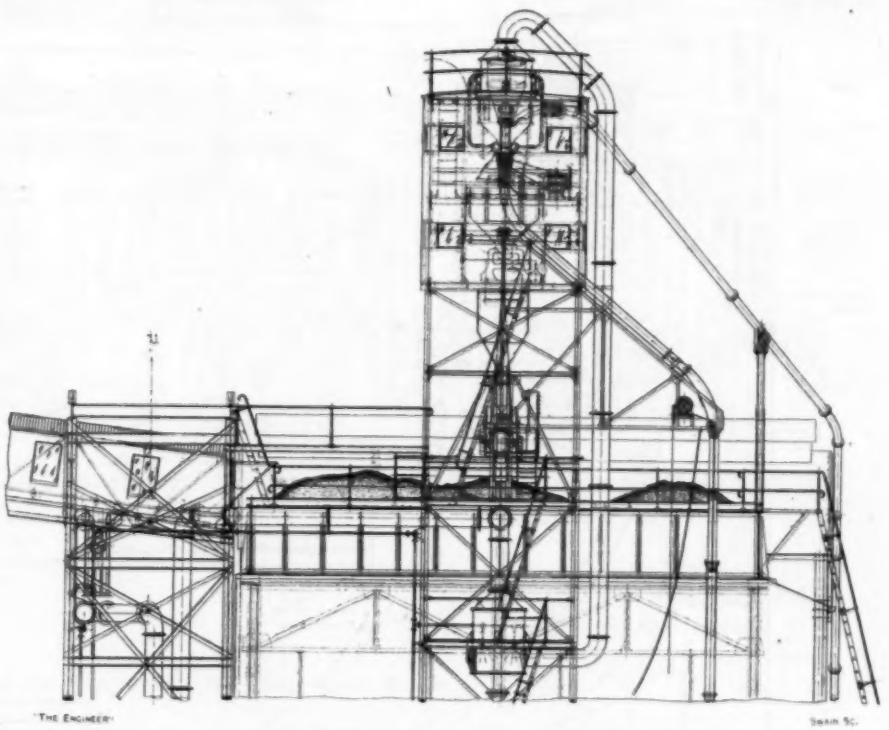


FIG. 2—INTAKE PIPE TOWER AND PIPING

TRAFFORD PARK POWER STATION—COAL AND ASH-HANDLING PLANT

HENRY SIMON, LTD., MANCHESTER, ENGINEERS

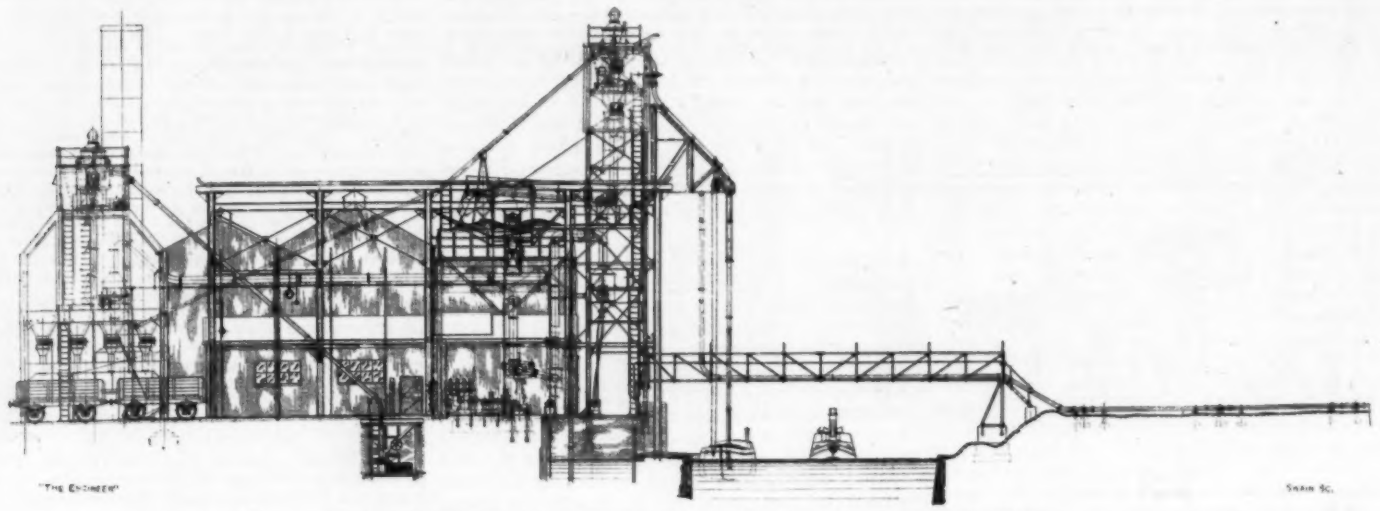


FIG. 3—ARRANGEMENT OF PNEUMATIC COAL INTAKE AND ASH EXTRACTION PLANT

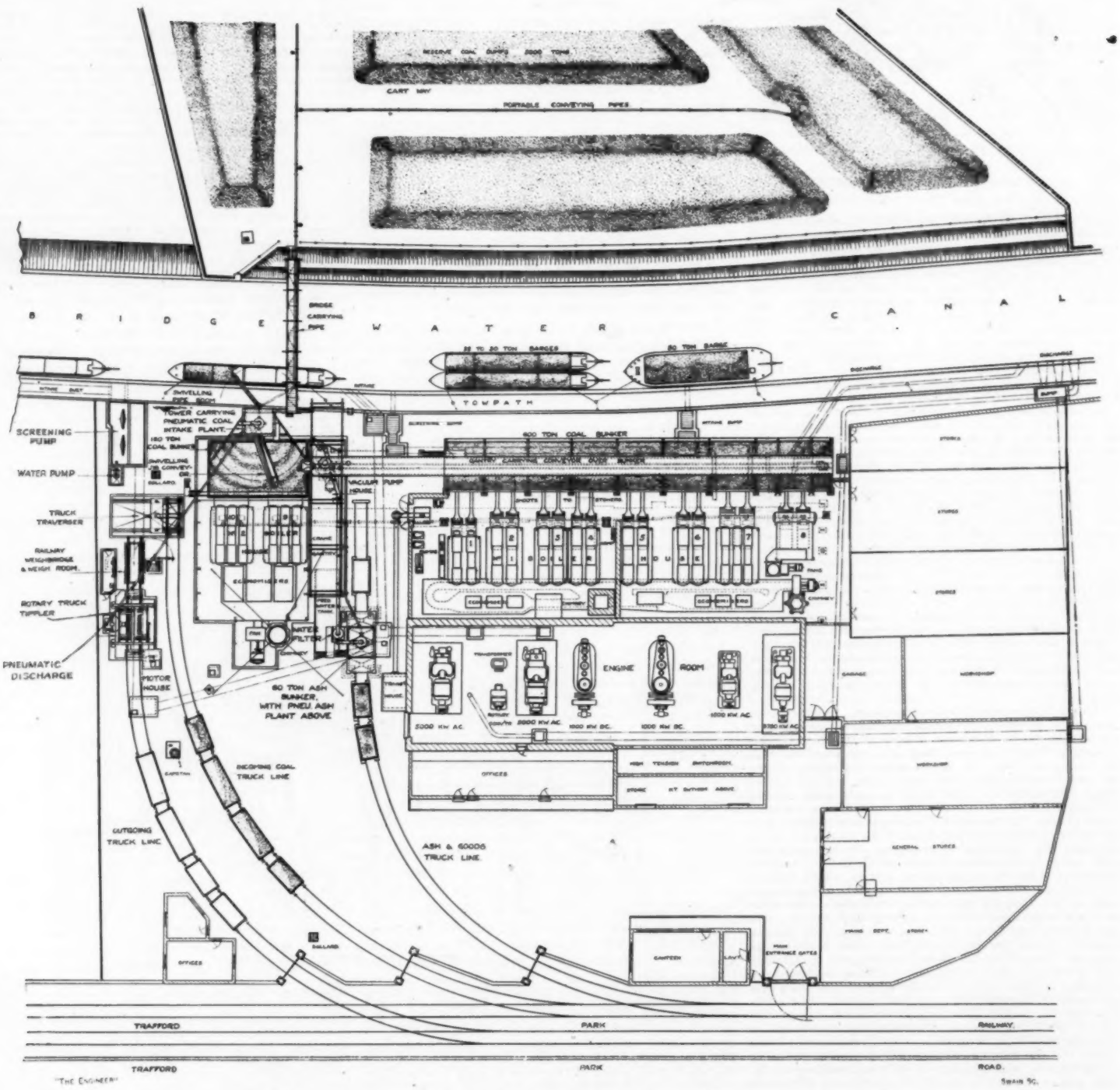


FIG. 4—PLAN OF THE STATION

wheel and chain from the firing floor. The coal is delivered to the various boilers by means of rectangular-section shoots having splayed mouthpieces, which are hinged and can be slung out of the way of the tubes wher they are withdrawn from the boilers. The bunker runs the whole length of the boiler-house and is continuous along its whole length. It is open at the top, except where the gantry covers it, but the sides and ends are sheeted in with corrugated iron.

It is interesting to note that the old bunker was dismantled and the new one erected without interfering with the working of the boilers; the gantry was built over the new bunker framework and the conveyor installed. It was fed by the existing grab through a temporary hopper and the boilers were fed through temporary shoots during the erection of the new bunker.

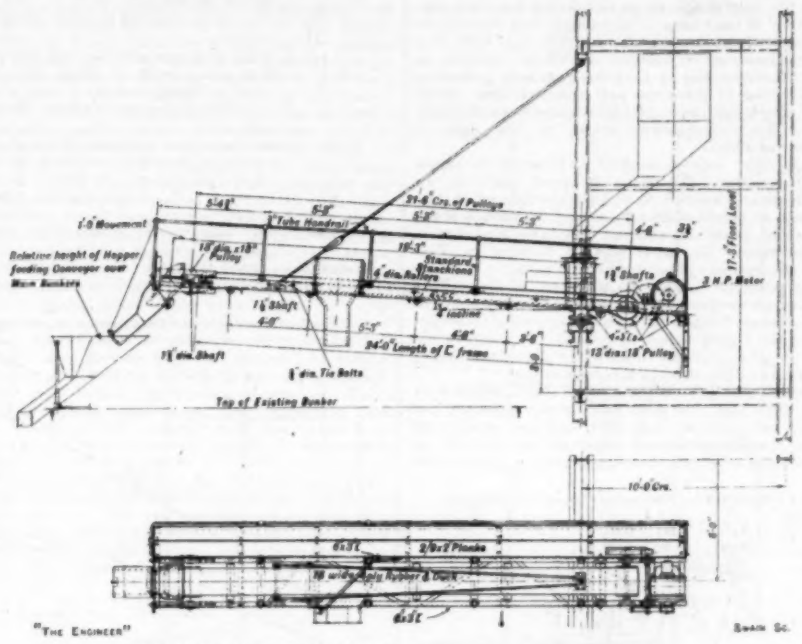


FIG. 5—ARRANGEMENT OF 16in. SWIVELLING BAND CONVEYOR

The conveyor gantry over the bunker is carried from the cross beams of the bunker itself by means of braced angle iron frames. The gantry is of braced angle iron construction throughout, the sides and roof being covered with corrugated iron sheets and the floor of wood planking carried on the angle iron floor members. Windows are arranged on each side at suitable distances throughout the whole length of the gantry. Stretch of the conveyor belt is taken up by means of a balance weight in a braced angle iron frame near the head end of the conveyor.

DISCHARGING FROM COAL DUMPS.

The main reserve coal dump for the station is situated on the opposite side of the Bridgewater Canal, and, prior to the installation of the pneumatic plant, this coal had to be loaded into carts and then brought round by road over a bridge, some distance away, and discharged by hand in the power station yard—a tedious and expensive method. Provision has now been made to discharge the dump by means of the pneumatic plant. A special light steel frame bridge has been erected across the canal in front of the power station to carry the pneumatic conveying pipe, and portable lengths of piping are added as required to reach to any part of the extensive dump. The maximum distance coal is conveyed pneumatically from the dump is 360ft. The near end of the pipe terminates in a bend to which the barge intake pipe can be joined up by means of a quick-coupling joint. The coal is then conveyed by the pneumatic plant in the same manner as in the barge discharging already described. The change over from one operation to the other can be performed in a matter of two or three minutes only. The capacity of the plant when occupied in discharging from the dump varies from 24 tons to 16 tons per hour, according to the distance over which the coal has to be conveyed.

RAIL-BORNE COAL.

A certain proportion of coal is brought to the station by rail, and in order to deal with it quickly and efficiently the pneumatic plant is also arranged for discharging from a special wagon tippler shown in Figs. 6 and 7. The same pump, receiver, tipper, &c., is used, but a special pipe line has been provided to connect up with the pit below the tippler. This pipe connects up with the receiver in the tower at the canal side and is provided with a valve so that it can be blanked off when not required. The pipe passes from the receiver to a steel-frame support on the end wall of the bunker over No. 2 boiler-house and passes across the yard to the tippler, which has been installed on the far side. The coal discharged from the wagon is carried pneumatically to the receiver, where it is delivered to the swivelling conveyor for transfer to either of the two bunkers. This section has a capacity of 25 tons per hour. The truck tipper, which was included in Messrs. Simon's contract, is of the "Whitehall" type, built by Strachan and Henshaw, Ltd., Bristol, and is capable of handling trucks up to 20 tons capacity. The time taken to empty a truck and return it to an upright position ready for removal is two minutes.

One of the most important features of the tippler is the automatic clamping of the wagon. The method of clamping adopted is exceedingly simple, is completely automatic and is perfectly safe, no damage being caused to the wagons. The principle adopted is simply that of gravitation and from the moment rotation begins the wagon is held securely by virtue of its own weight, without any auxiliary pressure of screws, chains, ropes or any other mechanism. The four essential units of the tippler are:—(1) Two steel rings braced together and rotating upon four rollers, two of which drive the rings by frictional contact; (2) a drive for the rings consisting of spur gearing operated by a totally enclosed compound-wound motor; (3) a swinging cradle which is suspended from the rings by links and is capable of vertical movement relative to the normal position of the rings; and (4) a truck table suspended from the cradle and capable of a small lateral movement relative to the cradle.

The action is as follows:—On the ring commencing to turn, the links between the truck table and cradle are brought to the vertical, after which the truck is brought, gradually up against the side buffers on the cradle, the links remaining vertical until the relative motion between truck and cradle ceases. The rotation of the rings being continued, the links between the cradle and the rings are brought to the vertical, after which the cradle—with table and truck—commences to move relatively to the rings, thus bringing the top of the truck up to the buffers, which are fixed to the rings. The truck and cradle remain held to the rings during the rotation to the required angle for discharge and until the reversal causes the links between the cradle and the rings again to assume the vertical, when the truck, still firmly held to the table and cradle, commences to unlock from the rings. The truck is not released from the cradle buffers until the reverse rotation is further continued, thus bringing the table links again to the vertical, after which the table swings away from the cradle buffers until the rail stop is reached. It will be observed that there is no internal mechanism beyond the heavy suspension links, but the truck is firmly held throughout the whole operation. Only one motion is required, namely, that of rotation of the cage, and that is done by means of a tramway type controller. An automatic series solenoid brake works in conjunction with the controller and holds the cage in any position when current is cut off or in the event of any failure of the supply.

A feature of this machine is its compact and sturdy construction. There are no frail parts which can be damaged by rough usage or exposure to the weather. There are very few members and they are of great strength. Over-rotation of the cage in either direction is prevented by cut-out switches and over-running buffers.

The wagons are brought in on one line of rails and transferred to the outgoing line, which passes through the tippler, by means of a hand-operated traverser. Before passing on to the tippler the wagons are weighed on a weighbridge, the weight being recorded by the usual method of a steelyard. An electric capstan, working in conjunction with bollards at various points, has been installed for handling the trucks both in and out.

An alternative method of discharging wagons has recently been installed. A branch pipe from the tippler pipe, provided with a valve, has been put in for discharging wagons direct. In that case the suction nozzle is plunged into the wagon itself and the coal is lifted out by pneumatic means and delivered to the receiver in the ordinary way. This pipe is carried from a light braced steel tower provided with a swivelling arm, mounted between the two sets of rails.

DUST COLLECTION.

Heavy dust is extracted from the air entering the receiver with the coal by means of a cyclone incorporated in the receiver itself. This dust, which, of course, is of value, is passed back to the coal through a rotary seal placed below the receiver and driven by the motor which drives the tipper. The dust passes into the stream of coal immediately it is delivered from the tipper seal and enters before the coal passes to the weigher. The air, freed from the heavier dust, passes out at the top of the receiver and is carried by mains to a water filter arranged on a platform near the bottom of the main tower. There the air is washed and dried and then passed through the air receiver to the vacuum pump. The fine dust washed out in the water filter is carried down a pipe to a sludge tank situated on the ground at the bottom of the tower, where it is collected; the coal dust is removed at intervals for use in the furnaces. The tank acts as a water seal and prevents any inrush of air.

THE VACUUM PUMP.

The vacuum pump, which is of the double-acting

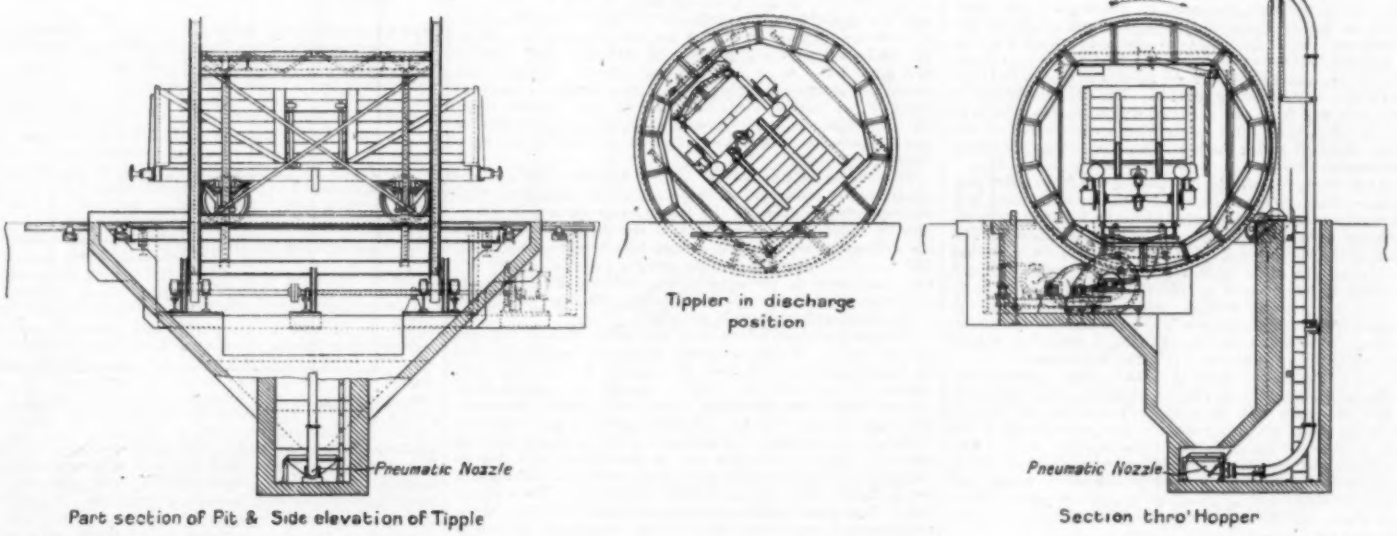


FIG. 6—20-TON "WHITEHALL" TYPE COAL WAGON TIPPLER

reciprocating type, has one cylinder. The valves are arranged top and bottom round the outside of the cylinder walls. The pump is of large diameter and short stroke and runs at 130 revolutions per minute. It is electrically driven through double helical machine-cut gearing by means of a 65 horse-power motor of the enclosed ventilated type, and it is mounted on a concrete foundation at one end of the No. 2 boiler-house. The suction pipe to the pump is provided with a relief valve which operates in case of a choke in the conveying pipe. The air exhausts to the atmosphere through a short pipe fitted with a weather cowl outside the pump house. The same vacuum pump is used for all operations, including the removal of ashes from below the boilers, a description of which is given below. Two sluice valves are fitted to the suction pipes above the air receiver in the pump house, so that the pump can be changed over from coal handling to ash handling or *vice versâ* in a few moments. These valves are operated by means of chain wheels and chain.

Extraction of Ashes from the Boilers.

The ashes from the boilers are also extracted pneumatically through mains connected to ashpits below the boiler-house floor. These mains are arranged in a pre-existing tunnel and are 6in. in diameter. Beneath each boiler are fixed two nozzles, one to each ashpit—formed as hoppers—these being fixed into the brickwork of the ashpit floor. The ashes are raked into the hopper and are carried away by suction to an ash bunker in the station yard. There are sixteen of these hopper nozzles serving No. 1 boiler-house and four for No. 2. In the latter case the ash falls direct into the nozzles from special ash hoppers fixed below the stokers. The nozzles are provided with auxiliary air inlets controlled by a valve, and a valve is also fitted at the point where the pneumatic pipe joins the hoppered portion in order to control the amount of feed passing into the main. There is also a cut-off slide for each nozzle so that any pit can be cleared as desired. The two nozzles on any boiler can be operated at the same time. By these means twelve hours' accumulation of ashes in any one boiler can be cleared in fifteen minutes. Five flue dust connections are also provided in the ash conveying main for attaching flexibles for cleaning out the flue chambers. The flue dust is carried to the ash bunkers, where it is deposited along with the ashes. The ashes are

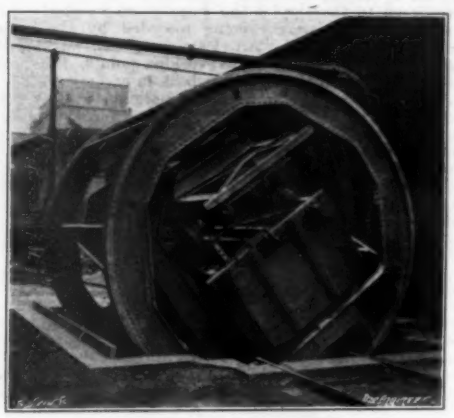


FIG. 7—20-TON WAGON TIPPLER

conveyed along the tunnels to a point between the two boiler-houses, where they enter a vertical pipe which carries them through the roof of the tunnel and then through an inclined pipe to the receiver placed above the ash bunkers. There the ashes are released through a tipper seal and delivered to the bunkers. The receiver, tipper, dust cyclone, and water filter are similar in design to those used for the coal-handling section. The only difference is in the dust seal from the cyclone, which in this case is in the form of a small tank fitted with a cone valve at the bottom, through which the heavy dust is discharged direct to the bunker.

The ash bunker itself, the erection of which was also part of Messrs. Simon's contract, has a capacity of 60 tons, is of reinforced concrete and is carried by four reinforced concrete stanchions mounted on mass concrete foundations. The bottom of the bunker is divided into four hoppers, provided with a chain-operated slide valve, each having a hinged swivelling delivery shoot so that delivery can be made to any part of a railway wagon. A separate line of rails is arranged below the bunker so that trucks can be run in for filling. In order to obviate the risk of explosion, a part of the bunker is open at the top to the atmosphere.

In the pump house there is a four-stage motor-driven centrifugal pump for supplying water for the sprays in the dust filters for both the coal and ash plants, the change over being made by plug cocks in the pump house. The water is taken from a sump in the station yard. The starters for the motors in connection with the pneumatic section of the plant are situated in the pump house and are each provided with an ammeter so that the performance of the plant can be seen at a glance, and control of the equipment to a certain extent is centralised.

Institution of Mechanical Engineers.—At a meeting of the North-Western Branch of this Institution, held on Thursday, February 3rd, at the Engineers' Club, Manchester, Mr. E. W. Tipple (Leeds) read a paper on "Machine Tools for Wheel and Axle Production." The subject was illustrated by numerous lantern slides and the author described axle machinery, wheel centre and tire machinery, tire fastening machines, assembly machines, continental and British practice in wheel tread turning and enumerated the essentials necessary for quick and sustained production. The principal developments alluded to were the increase in strength and weight of the machines to permit of heavy cuts being taken at speeds within the limits of the tools, the elimination of operations likely to induce fatigue of the operator and ease and control of the machine by electrical devices. A discussion followed the reading of the paper in which Messrs. F. W. Reed, H. Asbridge, Miller and Newton took part.

The Use and Economy of High-pressure Steam Plants.*

By Professor A. L. MELLANBY, D.Sc., Member, and Professor WILLIAM KERR, Ph.D., Member.

(*Concluded from page* 128.)

The Steam Cycle and its Probable Limits.

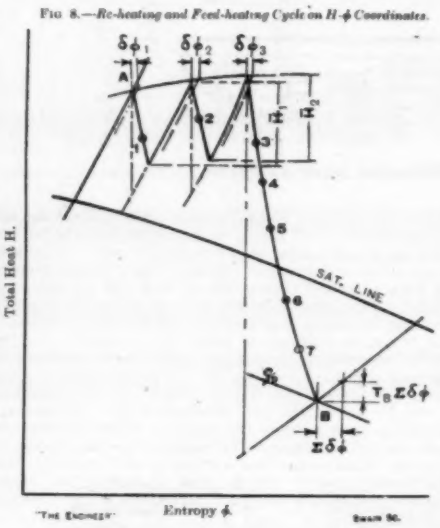
The modern steam cycle with its re-heating and feed-heating operations is now well known and definitely established. So far only single stage re-heating has been employed, but up to four steps in extraction feed heating are in use. The multitude of conditions that can arise in a general consideration of thermal efficiency changes, as influenced by variations in feed heating and re-heating and by extension of pressures and temperatures, would render any direct discussion of relative merits exceedingly confusing. The consequences would be lost sight of amongst the variables.

By far the most concise method of viewing the whole matter is to examine the probable upper limits to the different effects and thereby to realise directly and at once the full range of possible development. In such a study the detrimental influences and the inevitable loss characteristics constitute the all-important factors, a mere scrutiny of theoretical cycles is of no real value.

From the previous considerations given to the subject of materials and temperatures, it should be clear that the steam temperature limit is not a value capable of indefinite growth, and the stable nature of present-day temperature values in face of movement in all other directions clearly demonstrates the difficulties in this connection.

As a primary guidance, suppose it be taken that 250 lb. per square inch and 700 deg. Fah. steam pressure and temperature are perfectly safe with ordinary steels, and also that the nickel-chromium alloy results provide an indication of the qualities that higher orders of materials

Fig. 8.—*Re-heating and Feed-heating Cycle on H-ϕ Coordinates.*



possess. Now, by reference to Fig. 3 for the metal temperatures of the radiant heat surface, it will be found that the stated pressure gives a margin of 400 deg. Fah. on the ordinary steel. Carrying this along to the nickel-chromium line on the same diagram, it will be observed that the same margin is offered by the better material at 1500 lb. Again, on Fig. 4 for the superheater tubes, the same temperature margin of 400 deg. Fah. shows 900 deg. Fah. as a steam temperature. Hence, the materials data, as evolved from the previous studies, provide the rough ideas of 1500 lb. per square inch, 900 deg. Fah. as limits possible by the employment of special materials, and offering the same security as ordinary steel now provides.

The characteristic feature of the radiant heat surface conditions is reduction of the margins by pressure. The corresponding feature of the superheater surface is reduction by steam temperature. If it should be allowed that the ordinary steel is amply safe at 500 lb. per square inch, 750 deg. Fah., the permissible margin reduces to 300 deg. Fah., and 2000 lb. per square inch, 950 deg. Fah., appears as acceptable for the better material. The narrow change in the temperature level is notable.

The method just followed is less crude than it appears at first sight. Relative values alone are employed, and an important point of view is attained by a simple procedure. It is, however, hardly possible to imagine that, at the higher temperatures, even with better materials, the same margin will be sufficient, and it is not desirable to believe too readily that advance, even on the assumption that still better materials can be developed, will not be impeded by special difficulties, such as steam dissociation on the tube wall or excessive initial distortion. The authors have expressed[11] their conviction that 900 deg. Fah. represents in any event the probable maximum operating temperature for the steam plant, and they see no reason to depart from that opinion.

While the question of materials does—and must—decide temperature values the same information guides, to some extent, the point of view regarding pressures. Still, the rough range so indicated should receive any further illumination that thermodynamic methods can provide.

A general heat-entropy diagram for a combined re-heating and feed-heating cycle would appear somewhat as in Fig. 8.

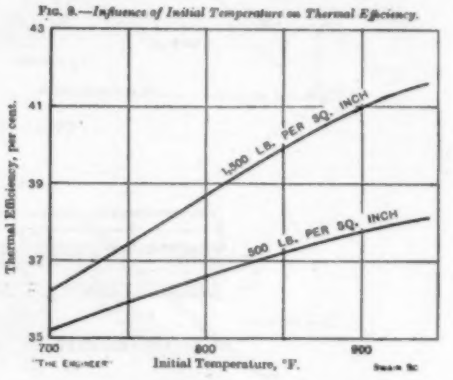
The actual expansion curves could be determined by means of the stage efficiencies expressed in (20) and (21). The upper feed-heating limit may be chosen or fixed according to the conditions under review, but equal steps over the feed-heating range then serve. The full line condition curves, as drawn, make no apparent allowance for pressure drops at change points. But these can be allowed for by summing the entropy increases resulting therefrom. The general expression for thermal efficiency then is

$$\text{T.E.} = \frac{(H_A+\Sigma H)-(H_B+\Sigma w H)-\{\Sigma w(H-H_B)+aP_1v'+T_B\Sigma\delta\varphi\}}{H_A+\Sigma H+\Sigma\delta h-(h_1+\Sigma w H)} \quad . \quad . \quad (22)$$

in which H = heat value at point on condition curve given by suffix.
h = heat value of liquid at point given by suffix.
H = re-heat.
w = extraction quantity for feed heating
$a\,P_1\,v'$ = feed pump work, P_1 being initial pressure and v' water volume; a is a reduction coefficient that also includes effect of pump efficiency.
$T_B\Sigma\delta\varphi$ = the heat loss resulting from all the small entropy growths occurring in the cycle, and not directly included in the main scheme; T_B is the absolute temperature at B.
$\Sigma\delta h$ = any direct heat losses that have to be allowed for.

It should be noted that the feed pump work is strictly a part of the thermodynamic cycle, and although negligible

Fig. 9.—*Influence of Initial Temperature on Thermal Efficiency.*

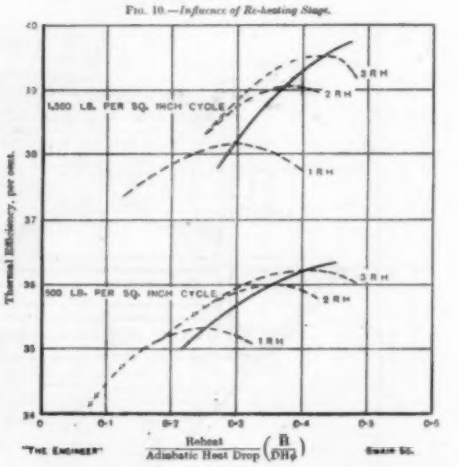


at ordinary pressures it becomes reasonably important at higher values, and is certainly a factor to be included in the consideration of pressure effects.

In discussing the influences of pressure, it is necessary to realise that there are apparently initial temperature, re-heating and feed heating effects involved. Actually, however, the initial temperature does not confuse the issue greatly, as there is progressive improvement with temperature at all pressures. Thus Fig. 9 shows the thermal efficiency variations for initial temperatures of 700 deg., 800 deg. and 900 deg. Fah. at pressures of 500 lb. and 1500 lb. per square inch. The cycle used is of the single re-heating type, with feed heaters on about 50 B.Th.U. liquid heat steps up to the initial pressure. From the similarity of these curves, it follows that quite legitimate conclusions regarding pressure limitations can be reached by confining attention to the upper temperature limit of 900 deg. Fah.

On the question of the most economical number and

Fig. 10.—*Influence of Re-heating Stage.*



position of the re-heating stages some analysis is necessary. It is obvious, however, that the number is very definitely limited by practical considerations, and more than two would in all probability be held undesirable. It is therefore useful to realise that while three may show a higher efficiency than two, the increase is not great, although increasing with pressure. This fact is brought out by properly including gain and loss effects in the analysis. The gains arising from extended re-heating are covered by the method of calculation, which includes stage efficiency effects. The special losses arise from pipe pressure drops and heat radiation.

It may be assumed that the pressure drop δP in one pipe length is given by

$$\delta P \propto \frac{u^2}{d \cdot V}$$

where u is steam speed and d is pipe diameter. This becomes

$$\frac{\delta P}{P} \propto \frac{u^2}{V^2}$$

when it is allowed that d varies as $\sqrt{V/u}$ and P V is

* The Institution of Mechanical Engineers.

[11] *Loc. cit.*

constant. Now, if it be assumed that design endeavours to keep δ P/P a constant, it follows that

$$d \propto V^{\frac{1}{2}} \propto 1/P^{\frac{1}{2}}$$

and if the heat losses are supposed to vary with d they become determinate.

An examination of 500 lb. and 1500 lb. per square inch initial pressure cycles leads to Fig. 10, for different numbers of re-heating steps at varying points in the cycles. In this calculation δ P/P has been taken at 0·025, and the single pipe heat loss as 10 B.Th.U. for a re-heating pressure of 100 lb. It will be seen from Fig. 10 that the best points for any assumed number of steps are readily determined, and the full line curves through these maxima show how efficiency is affected by number of stages on the understanding that the best points for re-heating are always chosen. It is quite clear that there is no great advantage in going beyond two, and this may hereafter be assumed.

In the matter of feed heating there is no real limit. The greater the number of heaters the greater the efficiency. But beyond a moderate number—say, below ten—there is only a slight improvement for each added heater. Fig. 11 shows the facts for the 500 lb. and 1500 lb. per square inch pressure cycles, and in making this calculation the only loss allowed has been one of 10 B.Th.U. difference between the final liquid heat of the feed and that corresponding to the maximum "tapping" pressure. From the curves it is found that liquid heat increments of about 50 B.Th.U. per heater represent a fair compromise between what could be done and what is worth doing.

The considerations given to the questions of temperature, re-heating and feed heating render the analysis of the pressure effect directly determinate. The range between 250 lb. and 2000 lb. may be examined, by means of the equations and methods already given and described, on the basis of an initial temperature of 900 deg. Fah., two-stage re-heating to this value, and extraction feed heating up to the initial pressure with the number of heaters fixed by the requirement of 50 B.Th.U. increments of liquid heat. The best points for re-heating can be determined by the methods that have provided Fig. 10, and after these auxiliary calculations have been performed the thermal efficiency for any pressure range becomes determinate. The feed pump work is also to be included, and the assumption is made that this varies from twice the

FIG. 11.—*Influence of Feed-heating.*

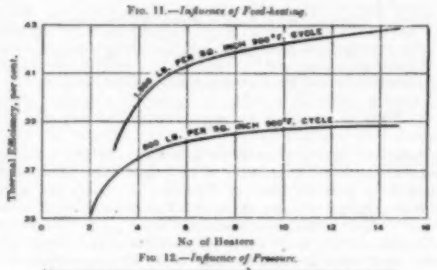
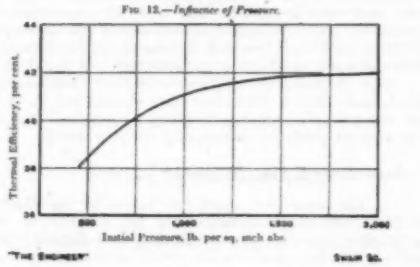


FIG. 12.—*Influence of Pressure.*



theoretical value at 250 lb. to three times the theoretical value at 2000 lb. per square inch.

The results of this complete series of calculations are shown by Fig. 12. It is clear that there is but little value in the last 500 lb., and hence the 1500 lb. 900 deg. Fah. limits indicated by the consideration of materials is not greatly upset by the lengthier thermodynamic discussion. Actually, however, there must be some degree of vagueness in the prospect of attaining the full standards of perfection assumed in the calculation, and in such an event even 1500 lb. becomes questionable. The authors have previously taken 1250 lb. as the best ultimate figure, in compromise between the higher values given by analysis and the not much poorer results indicated by lower and more desirable limits. They are even prepared to allow that 1000 lb. could justifiably be presented as a limit beyond which there is little chance of genuine gain. Below this, however, the fall is more rapid, and the range within which a true limit may be expected certainly lies between 1000 lb. and 1500 lb. per square inch.

Fig. 12 presents thermal efficiencies for the turbine cycle. Before a full performance can be defined there still remains the question of the boiler efficiency limit. This rests very definitely on the pre-heater design. With increase of pressure there is increase of the inlet water temperature to the boiler, and if the combustion air could only be pre-heated to the same value at all pressures there would naturally be an increasing chimney loss with pressure. But if it were agreed that the combustion air could be heated well beyond the inlet water temperature, corresponding to the highest likely pressure, the boiler efficiency should become, in an absolute sense, independent of pressure. The boiler and pre-heater surfaces could be so arranged that the gas temperature at their juncton would be the same for all pressures.

It would be theoretically possible, then, by suitable design, to bring the chimney temperature down to any preconceived value. The chimney loss would thus be reduced, but any attempts towards reduction entail increased fan power. Hence the best condition is when the total losses due to chimney temperature and fan power are the least. This condition may be examined for guidance regarding the best outlet temperature.

Let T_1 and T_0 be pre-heater inlet and outlet gas temperatures; t_1 and t_0 be outlet and inlet air temperatures; t_m the mean temperature difference, gas to air; φ the maximum allowable wall temperature; h the heat transmission coefficient; and K the pre-heater surface. Then to an approximate degree

$$\varphi = \frac{T_1 + t_1}{2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (a)$$

$$t_m = \frac{(T_1 + t_0) - (t_1 + t)}{2} \quad . \quad . \quad . \quad . \quad . \quad . \quad (b)$$

$$h \,.\, K \,.\, t_m = s_1 G (T_1 - T_0) = s_2 (G - 1)(t_1 - t_3) \quad . \quad (c)$$

in which s_1 and s_2 are, respectively, specific heats for gas and air, and G is the gas flow rate. Now, allowing that for large boilers

$$s_1 G = s_2 (G - 1) = s G \quad . \quad . \quad . \quad . \quad . \quad (d)$$

and eliminating T_1, t_1 and t_m, there follows—

$$\frac{h K}{s G} = \frac{2\varphi - (T_0 + t_0)}{2 (T_0 - t_3)}$$

But, for a tubular arrangement with area to gas flow A,

FIG. 13.—*Heat-Transmission Rates—Pre-heater.*

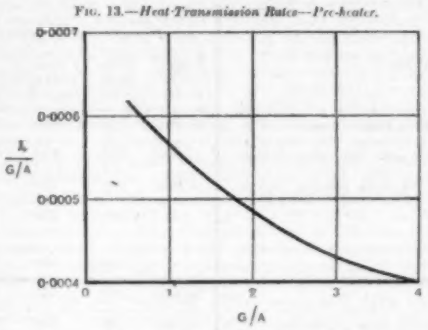
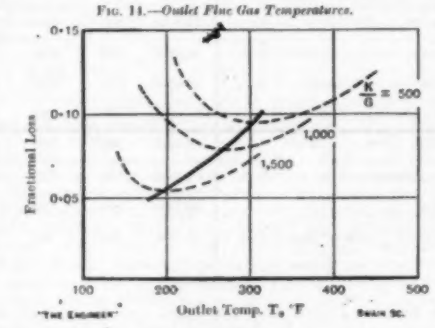


FIG. 14.—*Outlet Flue Gas Temperatures.*



length of flow l and hydraulic mean depth for passage m—

$$\frac{h K}{s G} = \frac{l}{s}\left(\frac{h}{G/A}\right)\frac{l}{m}$$

and hence

$$\frac{2}{s}\left(\frac{h}{G/A}\right)\frac{l}{m} = \frac{2\varphi - (T_0 + t_0)}{T_0 - t_0} \quad . \quad . \quad . \quad (23)$$

The energy loss per pound of fluid forced through the gas passages will be

$$\Delta p \,.\, V = f \,.\, \frac{l}{m} \,.\, \frac{v^2}{2g}$$

where Δp is pressure drop, V is specific volume, f is the friction coefficient, and v is the velocity. To give the fractional loss of heat value per pound of coal due to fan power, this may be developed to

$$\epsilon_1 = 2\left\{\frac{M \,.\, f}{2g \,.\, 778\, \epsilon\, F}\left(\frac{R}{P}\right)^2\right\}\tau^2\left\{\left(\frac{G}{A}\right)^2\frac{l}{m}\right\} \quad . \quad (24)$$

in which M = pounds gas per pounds coal.
ϵ = fan efficiency.
F = heat value per pound coal.
R = the "gas constant" and P = gas pressure (atmospheric).
τ = mean absolute temperature of gas.

The factor 2 is introduced in (24) on the simple assumption that doubling the fan power, as estimated for the gas side, will cover the air side also.

If the fractional chimney loss is

$$\epsilon_2 = \frac{s\, M\, (T_0 - t_3)}{F} \quad . \quad . \quad . \quad . \quad (25)$$

the total loss wherewith to exhibit the performance of the pre-heater is obtained from $\epsilon_1 + \epsilon_2$.

There is no other direct way of fixing the upper limit for the combustion air temperature than by the allowable metal temperature. It may then be taken, for the sake of this discussion, that φ in (23) is 900 deg. Fah. In this way, consistency with previous lines of argument is maintained.

For the assessment of actual values, the following have been taken:—

M = 15, f = 0·011, ϵ = 0·50, F = 13,000, P = 1 atmos., t_3 = 60 deg. Fah.

The values for $\frac{h}{G/A}$ are represented by the curve shown in Fig. 13. Then for any assumed T_0 and $\frac{h}{G/A}$ values the total loss is calculable, and the corresponding figure for K/G can be obtained.

Fig. 14 shows the results for a few values of K/G—surface per pound gas per second. For any one value it will be seen that there is a limiting chimney temperature, and the only manner in which this can be reduced is by increase of K/G. It is clear that the pre-heater surface rapidly reaches enormous dimensions on the attempt to get very low outlet gas temperatures, and it is questionable whether there are any real prospects below, say, 250 deg. Fah. It will, of course, be understood that the condition incorporated in the calculation of a fixed maximum metal wall temperature of 900 deg. Fah. corresponds to about an 800 deg. Fah. combustion air temperature. This is naturally high, but the mode of calculation would lead to a precisely similar conclusion, even if a lower limit air temperature was adopted. The real point is that reduction below about 250 deg. Fah. is possible only with excessive pre-heater surfaces.

With a 250 deg. Fah. outlet temperature and a normal amount of water vapour in the chimney gases, it will be difficult to get above 91 to 92 per cent. boiler efficiency, all other operations being perfect. It is therefore impossible to contemplate a boiler efficiency above, say, 90 per cent. at high pressure. Higher values than this have been quoted, but they are for low pressures with economisers and relatively small air pre-heaters. With the economiser function performed wholly by extraction feed heating, and the gain ensuing therefrom already credited to the turbine, it would hardly be correct to allow quoted values to influence more extreme and more difficult cases unduly.

It follows, finally, that for the high-power land plant no improvement seems possible beyond the conditions represented by, say, 1250 lb., 900 deg. Fah., two-stage re-heating, eight or nine feed heaters, boiler without economiser but with air pre-heater designed for a 250 deg. Fah. gas outlet and giving a total boiler efficiency of 90 per cent. The present-day position as regards materials reduces the immediately allowable temperature very definitely. The direct incidence of present costs would reduce the pressure somewhat, but steady advance in the one line and natural changes in the other will allow of progressive advance towards the specified conditions.

The differences between land and marine plants lie in size and particularly in the dominant requirement of reliability in the latter case. It is certain that the marine plant will not develop right up to the limits open to the land plant. Strictly, since both are power units, the same limits should apparently apply, but a brief consideration of what is entailed by, say, re-heating on shipboard, will soon show the differences necessary. In fact, no re-heating is really likely, and feed heating with its complications will be somewhat more limited than in land practice. Pressures and temperatures will also be lower, and for the purpose of having a specific set of conditions, it might be permissible to take 1000 lb. per square inch, 850 deg. Fah., no re-heating, four or five stage feed heating, as the marine plant limit. It is highly probable that even this does not fully assess the necessary differences between the two types of plant.

FIG. 15.—*Land Plant Efficiencies.*
(See Table 1.)

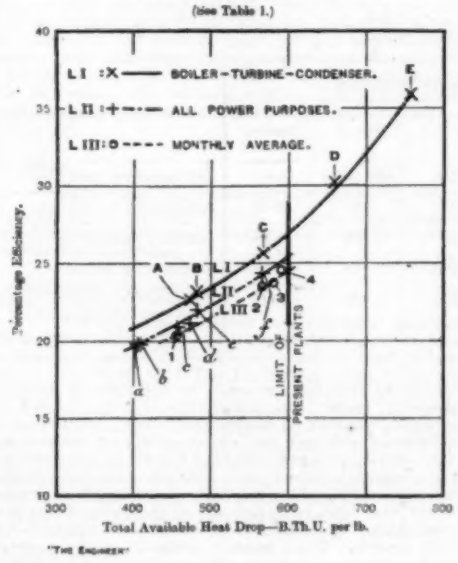
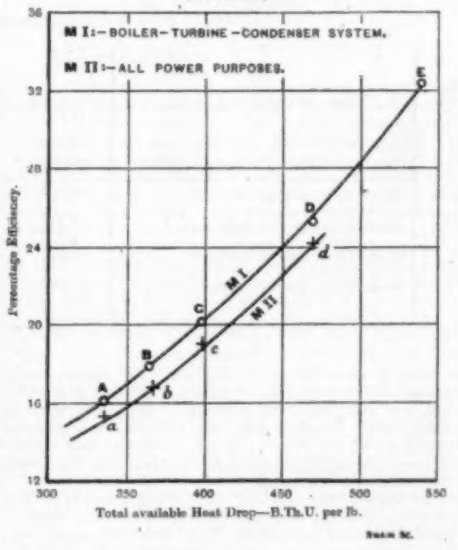

L I :X—— BOILER-TURBINE-CONDENSER.
L II :+-·-· ALL POWER PURPOSES.
L III:○---- MONTHLY AVERAGE.
Percentage Efficiency.
LIMIT OF PRESENT PLANTS
Total Available Heat Drop—B.Th.U. per lb.
"THE ENGINEER"

FIG. 16.—*Marine Plant Efficiencies.*
(See Table 2.)



PROGRESS TOWARDS THE LIMITS.

It was claimed that the best method of viewing the economy of high-pressure arrangements lay in an examination of the limiting conditions. Some views of these have

been achieved, and the whole range of possible improvement can now be at once appreciated by linking up these limits with present conditions. A graphical presentation of the data is easily possible and provides the clearest view. Land and marine plants may be shown separately; process plants and locomotive conditions have to be ignored, there being no effective progress to record.

The land plant data are shown by Fig. 15. The scheme is to show by the upper full curve L I points representative of best performances—actual or expected for the present, and estimated for the future. In this curve no allowance is made for power auxiliaries; it represents the thermal efficiency of the boiler-turbine-condenser system only, and the previously estimated limit conditions mark the final point. In L II an attempt is made to indicate how the power auxiliaries affect the conditions; while L III is an indication of how monthly averages on high load factor compare with the more ideal conditions. The authors do not pretend to any finality in regard to these curves, but they consider that their inclusion should facilitate correction and comparison by those who possess the proper information.

The main features of the plants represented in Fig. 15 are as stated in Table I.

For marine plants Fig. 16 applies. The upper curve M I is, as before, for the boiler-turbine-condenser arrangement, and applies mainly to high-power liner practice. The lower curve M II covers similar conditions, but is for all power purposes. The points plotted in Fig. 16 are described in Table II.

The curves in Figs. 15 and 16 show the range of performance over a period from the immediate past through the present to the probabilities of the not too distant future. Achievement to the full extent mapped out on the charts depends very directly on an advance in materials, but the need in that direction is not so much for entirely new metals as for the fuller use of materials already available. Experience with these is necessary, and, provided it ultimately proves satisfactory, the scope for the thermal improvement of the steam plant is attractive and stimulating; and the applications of the system as so improved are manifold and universal.

In the various calculations throughout this paper and in the preparation of diagrams, the authors have received able and generous assistance from their colleagues, Mr. P. S. Caldwell, A.R.T.C., Mr. O. Sneeden, B.Sc., and Mr. J. C. Orkney, B.Sc., and this assistance they desire most gratefully to acknowledge.

TABLE I.—*Land Plants.*

Curve.	Ref. letter.	Name of station.	Power company.	General conditions. Power unit, K.W.	Pressure, lb./in.²	Temperature deg. F.	Reheating steps.	Feed heating stages.	Point on curve obtained from.
L I	A	Susquehanna	Metropolitan Edison Power Co., Pennsylvania, U.S.A.	30,000	350	670	None	Two	Estimate from data in *Power*, Dec. 25th, 1925
	B	Seal Beach	Los Angeles Gas and Electric Corp., California, U.S.A.	35,000	375	700	None	Four	Estimate from data in *Power*, June 2nd, 1925
	C	Crawford-avenue	Commonwealth Edison Co., Chicago, Illinois, U.S.A.	60,000	550	725	One	Three	Estimate from data supplied by the company
	D	—	—	—	1,500	750	One	(65° to 550°)	Sir Charles Parsons' estimate in "Steam Turbines," World Power Conference, "Proc.," 1924
	E	—	—	—	1,250	900	Two	Eight	Estimate for authors' "Limiting Cycle"
L II	*a*	Rotherham	Rotherham Corporation	30,000	200	640	None	None	Estimate from data in *Engineering*, Jan. 18th, 1924
	b	74th-street power station	Interborough Rapid Transit Co., New York City, U.S.A.	60,000	220	540	None	None	Estimate from data in *Engineering*, Aug. 25th, 1922
	c	Dalmarnock	Glasgow Corporation	19,000	260	710	None	One	Estimate from data supplied by Mr. R. B. Mitchell
	d	Susquehanna	Metropolitan Edison Power Co., Pennsylvania, U.S.A.	30,000	350	670	None	Two	Estimate from data in *Power*, Dec. 29th, 1925
	e	Seal Beach	Los Angeles Gas and Electric Corp., California, U.S.A.	35,000	375	700	None	Four	Estimate from data in *Power*, June 2nd, 1925
	f	Crawford-avenue	Commonwealth Edison Co., Chicago, Illinois, U.S.A.	60,000	550	725	One	Three	Estimate from data supplied by the company
L III	(1)	Dalmarnock	Glasgow Corporation	19,000	260	710	None	One	Estimate from data supplied by Mr. R. B. Mitchell
	(2)	Crawford-avenue	Commonwealth Edison Co., Chicago, Illinois, U.S.A.	60,000	550	725	One	Three	Estimate from data supplied by the company
	(3)	Philo	Ohio Power Co., Ohio, U.S.A.	40,000	560	710	One	Two	Estimate from data supplied by the company
	(4)	Weymouth	Edison Electric Illuminating Co., Boston, Mass., U.S.A.	35,000	1,200	700	One	Three	Estimate from data supplied by the company

TABLE II. *Marine Plants.*

Ref. letter.	Type of vessel and drive.	General conditions. Power unit H.P.	Pressure, lb./in.²	Temp., deg. F.	No. of feed heating stages.	Point curve obtained from
A, *a*	Ocean liner, direct-coupled turbines	20,000	210	385 (sat.)	None	Estimate from trial data
B, *b*	Ocean liner, geared turbines	10,000	210	485	None	Estimate from trial data
C, *c*	Ocean liner, geared turbines	10,000	220	590	None	Estimate by authors
D, *d*	Ocean liner, geared turbines	20,000	500	700	Three	Estimate by authors
E	Ocean liner, geared turbines	20,000	1,000	850	Five	Estimate for probable limiting cycle for marine work

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AT the annual meeting of the Institution of Railway Signal Engineers on Wednesday evening last, Mr. E. F. Fleet, the signal engineer for the North-Eastern area of the London and North-Eastern Railway, was elected President for 1927–28, and Mr. C. M. Jacobs, assistant signal and telegraph engineer, Great Western Railway, the Vice-president. The report showed that there had been fifty-three new members elected during the past year, that nineteen had ceased their membership, and that there are now 474 home members and 175 overseas.

South African Engineering Notes.

A Union Rubber Industry.

There has been a tendency to deride the possibility of the Union becoming rubber producing, but the fact that a big amount of capital has been put up by well-known South Africans, and the report of Dr. Erich Neufeld, analytical chemist, has resulted in a more serious examination of the prospects. If the information obtained from various sources is correct, it would seem that the proposed rubber industry will be a very profitable undertaking. The Union Rubber Corporation, Ltd., formed with a capital of £150,000 for the purpose of acquiring certain areas in the Eastern Province of the Cape, and to develop and market the latex of *Euphorbia*, or other well-known South African tree of the rubber family with the extraction of crude rubber with the by-products natural thereto, experienced no trouble in obtaining the required capital. The area which the company will obtain is about 25,000 acres, and it is estimated to contain 15 to 20 million trees. Dr. Neufeld, who is the Corporation's consulting and anaytical chemist, and a highly qualified man, has carried out protracted tapping examinations, analysis and vulcanisation tests and states that "in tapping about twenty trees in the time of two hours three gallons of latex, of pure white quality, were extracted. This was at once coagulated, and after separation of the resin the resulting caoutchouc proved of excellent quality. A vulcanising test confirmed this opinion. The average output can be computed at about 3 lb. of pure caoutchouc annually per tree. The resins are suitable for varnishes of the best sort, being very flexible and yet of great hardness." Dr. Neufeld points out that the company can enter on the producing stage at once. Dr. Schidrowitz, F.C.S., F.I.R.I., an eminent specialist on commercial rubber, has carried out exhaustive analyses and examinations on specimens of latex and caoutchouc submitted to him, as extracted from the *Euphorbia*, through Dr. Neufeld, and states that in his opinion the rubber should be for commercial purposes from 70 per cent. to 80 per cent. of the value of first grade plantation. Authorities in New York make similar favourable reports. The company expects, on the authority of its experts, a profit of £248 per diem. A factory has been obtained at Kingwilliamstown (Eastern Province of the Cape), and the machinery required is being obtained at once. It would appear that Namaqualand has also great potentialities as a rubber producing country.

Dr. Neufeld, in a paper read before the Chemical, Metallurgical and Mining Society recently, gave a considered statement of the prospects of rubber production from South African *Euphorbiæ*. Hitherto attention has been directed chiefly to the hard-barked forest trees which it is proposed to tap. But Dr. Neufeld draws attention to an immense but compact area of rubber-bearing bush in Namaqualand, which can be cut and crushed more easily than sugar cane, so that the cost of harvesting becomes almost negligible, and all labour can be obtained locally. There are said to be a million acres upon which this easily-handled bush—*Euphorbia dregeana*—grows densely. It is estimated that an acre carries about 70 bushes, averaging one-eighth of a ton weight each. Assuming a weight of 100 lb. a bush, Dr. Neufeld shows that to cut the bush, extract the latex and finish the product for export (including all charges), will not cost more than 7d. per pound of rubber (f.o.b.). All tests show that the bush yields at least 5 per cent. of its weight as rubber-latex. Accordingly it is calculated that there is standing awaiting harvest something like 25,000 tons of rubber. Further, it is not a wasting asset, but one that is actually improved by cutting. Where one branch grew before three or four appear after pruning. The bush also grows readily from truncheons, and a native should plant about an acre a week; while the plant then looks after itself. There are, too, numerous by-products. The well-known consulting chemists of Amsterdam, Drs. van Hamel Roos and Harmens, add to their certificate of analysis:—"We beg to draw attention to the fact that from the material submitted a very estimable and highly satisfactory varnish can be obtained." There are stated to be a number of uses to which the vegetable fibre can be put. If the very satisfactory reports of the experts are borne out by tests on a commercial scale, there is no doubt that much capital will soon be forthcoming to develop this industry, and unquestionably the Government will greet any well devised scheme for administering a project of such magnitude and promise. If so, there will be a large quantity of crushing and other machinery required, and British manufacturers should see to it that they become conversant with what will be required so as to be able to quote for reasonably early delivery.

Cape Town's Floating Dock.

The small dry dock purchased by the Railways and Harbours Administration for the purpose of lifting the smaller type of steam coasting and fishing vessels, trawlers, whalers and similar craft, weighing up to 500 tons, has been put into commission, and is proving most useful—formerly the only means had been to haul these vessels up on the "patent slip" or put them in the dry dock. The dock was built to the designs of Messrs. Clark and Stanfield, Victoria-street, London, by Head, Wrightson and Co., Ltd. It has a lifting capacity of 450 tons to 500 tons, and its principal dimensions are:—Overall length, 137½ft.; overall breadth, 40ft.; breadth of side wall, 6½ft.; moulded depth of pontoon, 6½ft. It will submerge to a depth of 15ft. to the keel blocks, the height of the latter being 3ft. 8in. It is provided with thirty air chambers, and the twelve pumps installed in an engine-room situated 40ft. above the surface level are so arranged that all submerging and lifting operations are controlled by one person.

Electricity Undertakings.

The Sterkstroom Town Council is about to borrow money for the installation of a general electric lighting scheme, and all works, requirements, &c., incidental thereto. The town of Villiersdorp has had a report drawn up on a proposed hydro-electric undertaking, a head of 450ft. being available in Wolfies Kloof. The report is, on the whole, favourable to the scheme, but, so far, no action has been taken by the municipal authorities. The Town Council of Rouxville has had two electric and water schemes passed, and a start has been made with the buildings and reservoirs. The orders for the plant, pipes, wiring, &c., have been placed. Kroonstad is raising a loan for various purposes, including extensions to the electric light plant. Negotiations have recently been concluded between the Cape Town City Council and the Camps Bay Tramway Company, Ltd., whereby the latter will shut down its existing generating station at Camps Bay, and will take a supply of electric energy from the Council for traction purposes and for lighting and motive power purposes in its tram sheds and workshops, at a flat rate of 1·062d. per unit measured on the 11,000-volt side of the converters.

Production of Oil.

The exploitation of the many millions of tons of oil-bearing torbanite and other shales that have already been proved in the Transvaal, has again come into prominence. A year or so ago a good deal was heard about the development of these torbanite areas, but certain

technical and financial difficulties prevented the realisation of these attractive prospects. The difficulties were, however, not insuperable, and recently an opportunity was afforded of examining, at Johannesburg, a sample of petrol produced from Transvaal torbanite, and it is now announced on good authority that a German expert, to whom has been entrusted the responsibility of determining finally the prospects of developing these deposits as a commercial proposition, is investigating the matter. If his decision is favourable there is already available—so it is stated—a sum of approximately £2,000,000 to be advanced by one of the best known and most powerful German banks, for the financing of the undertaking. This provision has been made on analyses and experiments with torbanite previously sent to Germany. Three samples, each of increasing size, have been sent to that country for the purpose, and the extraction of oil therefrom has, it is reported, been so satisfactory as to warrant further and final investigation on the spot by an expert representing the interests prepared to exploit this potential wealth. Transvaal torbanite oil content has, according to some accounts, been proved to be approximately 80 gallons to the ton, though other investigators give it as somewhat lower on the average. One of the facts that have hitherto operated against the development of Transvaal torbanite deposits has been the lack of any means of refining the crude oil when produced. Now, steps are being taken to erect a refinery—with the assurances of Government support—and this scheme will form a valuable link with the project for exploiting torbanite areas and with other schemes for the production of oil in this country. It is possible that the various interests may entertain the establishment of a central refinery. In the event of a company undertaking the production of oil from torbanite, it will receive the Government bounty which Parliament agreed to some time ago.

Automatic Rotary Sub-station.

An automatically controlled electric rotary sub-station equipment has recently been installed and put into service in a new building at the corner of Hewitt and Frere-roads, Durban, in the centre of a populous and growing district, to supply direct current at 550 volts to the tramway routes to the Glenwood and Umbilo termini. The equipment, supplied by the Metropolitan-Vickers Electrical Company, Ltd., is practically a duplicate of those already installed in the Greyville, Berea Park and Cato-street sub-stations, with minor improvements which increased experience in the operation of this type of plant has proved to be of advantage. The equipment comprises:—(1) A 500-kilowatt six-phase compound-wound interpolar rotary converter, supplying 950/910 ampères, at 525/550 volts direct-current, at a speed of 1000 revolutions per minute, arranged for tap starting and complete with oscillator, speed-limiting device, motor-operated direct-current brush lifting gear, &c.; (2) a 500 k.V.A. 3/6-phase 50-period 6600/390 volt star/double star connected oil-immersed transformer in boiler iron tank with external tubes, oil conservator, chloride breather, &c.; and (3) the necessary extra high-tension and low-tension switchgear, relay panel, direct-current machine panel, three traction feeder panels, coupling feeder panel, spare parts, &c. The guaranteed full load efficiency of the converter at unity power factor is 95·4 per cent., that of the transformer being 98·3 per cent.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Situation.

MIDLAND and Staffordshire iron and steelmasters find business very slow. Buyers are confining their orders to the severest limits, and it has now become apparent that a general depreciation of iron and steel values is a condition precedent of any considerable reinvigoration of trade. However, at the moment so much of the production is going to wipe out arrears that owners of mills and furnaces are very reluctant to make price concessions on current consumptive demand. When approached by consumers for lower rates they cite, amongst other things, the higher railway charges now in force. This week has, nevertheless, seen some slight wavering on the part of ironmasters. Many Midland smelters have eased their quotations for business placed over the next three months, while finished iron mills have cut their prices in an endeavour to compete with Lancashire houses. Galvanised sheets have declined further. In the steel department, however, prices show no signs of sagging. Demand here is so far in excess of output that any reduction of values is not looked for for some time yet. The basic industries in this district are steadily developing their resources, and in some cases output has now reached pre-strike level. The outlook still lacks clarity, and industrialists generally are acting cautiously.

Pig Iron Values.

Many Midland smelters are becoming concerned regarding outlets for their production. Buying remains exceedingly quiet alike for foundry and forge qualities, and in an endeavour to secure something a little better than the tonnages recently placed, and required for immediate needs, they have intimated their willingness to accept a reduction of half-a-crown per ton for business placed over the next three months. Present prices smelters hold are absolutely necessary to cover present production costs, but in order that they may be able to see their way a little farther ahead they are ready to make some sacrifice. Derbyshire No. 3 foundry iron was quoted on 'Change in Birmingham to-day £4 2s. 6d. to £4 5s.; forge, £3 18s.; Northamptonshire foundry, £4; and forge, £3 13s. Midland furnacemen have a number of old contracts to clear off, but new business does not balance output. Birmingham merchants have the greatest difficulty in selling iron in the present unsettled condition of the market. Neither is there any indication that the foreign brand is being bought to any large extent. Continental iron can be delivered in the district at £4 13s., as compared with the Northampton quality at £4 10s. delivered. The present weakness of continental values, however, has the effect of restricting the importation of foreign material to narrow limits. Arrangements have been completed for relighting additional blast-furnaces in the Midlands, but little haste is shown in putting plans into execution, the high price and comparative scarcity of coke still acting as a check. It is stated that the number of blast-furnaces now in operation throughout the kingdom approximates to the 147 which were producing last April. They have not all settled down to normal working yet, however.

Crown Bars Cheaper.

Staffordshire ironmasters producing Crown quality bars, eager to secure orders in competition with Lancashire houses, have reduced their quotation some 5s. per ton. Since work resumed at the mills little new business has been received by Staffordshire makers, and order books in this department are becoming thin. On 'Change in Birmingham to-day—Thursday—most of the Staffordshire makers mentioned £12 5s. for Crown bars, but it was thought they would not miss a good order for the sake of 5s. Indeed, a few mills actually quoted £12, a figure at which some Lancashire houses offer delivery in the Midlands, and a figure equivalent to the rate applying to the export trade. It did not appear that the reduction in price was conducive to any more orders. A steady business is being done in marked bars at £14 10s., but the greater part of the activity here is on account of orders booked months ago. Staffordshire makers of nut and bolt and fencing bars continue their endeavours to get £11 per ton for this material. They meet with little success, however, for Belgian mills have no difficulty in retaining the business of the nut and bolt and hurdle makers, whose requirements they are supplying at a delivered price of £6 5s.

Steel.

The steel trade does not show much new buying, but the mills are busy on old contracts. Little change is to be noted in structural steel. There is a wide margin here between home and foreign prices. In no case is there any activity of demand, the weakness in the continental steel market confirming importers in their abstention from all buying that is not imperative. English billets are offered at £7, which is well over £1 in excess of the cost of imported billets. The output of steel plates has grown somewhat. Heavy joists, however, are still as scarce as ever. Continental material is still being bought in small quantities. Makers are endeavouring to attract the British buyer with lower offers and cutting between themselves. Belgian joists are quoted at £5 9s. Antwerp, 1s. less than a week ago. The price when carriage charges are added would be £6 15s., as compared with £7 17s. 6d. for British steel. Steel bars can be had at £6 5s., and billets £5 7s. 6d. After a long interval wire rods of all-English make have reappeared on the market. They are quoted at £9 15s. The price of rods rolled in this country from imported semis is £9 5s.

Galvanised Sheets Weak.

The weakness of galvanised sheets is perhaps the most noticeable feature of the market. Prices have now fallen to £15 10s., the lowest point they have touched since the war. The price mentioned on 'Change to-day was £15 10s. to £15 12s. 6d., but it is doubtful whether this is really the basis. It is believed manufacturers are badly wanting orders, and would accept still lower rates. It is reported that some welcome contracts have recently been negotiated with South America, the West Indies, and Australia, but they are not sufficient to strengthen values. The mills state that this period of the year is generally quiet in the trade, but new buying is particularly slow this year. The tin-plate trade is similarly affected, the Indian and Far Eastern business showing little evidence of vitality.

Scrap.

Steel scrap continues to sell slowly at about £3 7s. 6d. delivered South Wales. Buyers have arranged their current requirements, and are not anxious to place much forward business.

Structural Engineers.

The first annual dinner of the Midland Counties Branch of the Institution of Structural Engineers was held on Saturday last in Birmingham, Mr. J. C. Telford presiding. The toast of "The Institution" was submitted by Dr. C. M. Walker, who spoke of the good work carried out by the body since its foundation in 1908. Mr. J. H. Deane (President), who responded, alluded to the remarkable increase which had taken place in the membership of the Institution. Four years ago, he said, they numbered 1200; to-day they were over 3000 strong, and there was every indication that in the course of the next few years they would increase in an even greater ratio.

Edge Tools.

The Midland edge tool industry remains quiet, indeed there has been a falling off in business as a result of the unsettled state of affairs in the East. The African, South American, and Australian markets are also reported to have been smaller buyers than usual, of recent months. The lack of demand is attributed, to some extent, to the competition of German makers of inferior tools. Local manufacturers have adequate supplies of fuel, but material is still difficult to obtain.

New Severn Bridge Tender.

The Salop County Council on Saturday last accepted a tender of £58,966 by a Glasgow firm for the erection of a new reinforced ferro-concrete bridge over the Severn at Atcham. The Ministry of Transport, it was stated, had indicated its approval, and that the scheme would rank for 75 per cent. grant. No fewer than thirty-two tenders for the work were received.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

To the River Plate.

AN interesting development in direct shipping services from the Manchester Ship Canal is presaged by the official announcement this week of a monthly sailing from the docks here to the River Plate, the venture being the joint enterprise of Manchester Liners, Ltd., and Houlder Brothers and Co., Ltd. The service will be opened towards the end of the present month by the Panama Transport, and regular sailings each month will be maintained by other vessels. Direct shipping between Manchester and the River Plate ports should be of very considerable economic advantage and a saving should be effected in transport and handling charges as a result. The engineering industries should be among those which will benefit, for a by no means unimportant trade is done by engineering firms in this area, particularly makers of textile machinery, with South American countries. Altogether, the enterprise should not fail because of lack of support from shippers. Return cargoes will, of course, be made up primarily of South American produce. Apart from frequent services between Manchester and most of the continental ports, regular sailings are also made to the United States and Canada and Australia.

Foundry Progress.

Mr. V. C. Faulkner, President of the Institute of British Foundrymen, was optimistic in a speech at the annual dinner of the Lancashire Branch of the Institute, held here last Saturday. He had recently examined at Birmingham, he said, a list of contracts for foundry work which was the longest he had ever seen. Since then the list had grown longer, and in the near future it would no doubt grow longer still. An interesting announcement of the President was that an international foundry congress would be held in this country in 1929, probably in London, and he expressed the hope that the high standard set by the United States and France in connection with similar gatherings held in those countries would be maintained here. Sir Benjamin Longbottom, President of the Manchester Association of Engineers, said he was satisfied that in the event of any important recovery in the engineering industries full support would be accorded by the foundry industry. During the proceedings a presentation was made by members of the Lancashire Branch to Mr. Tom Makemson, who, for a number of years until his appointment as general secretary of the Institute last year, carried out the duties of honorary secretary of the branch. Mr. Makemson was formerly a member of the research staff of the Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester.

Personal.

Alderman William Walker, one of the seven members of the Central Electricity Board, whose appointment was announced this week by the Ministry of Transport, is a director of the engineering firm of Henry Simon, Ltd., Manchester, deputy chairman of the Electricity Committee of this city, chairman of the National Joint Industrial Council for the Electricity Supply Industry, and also chairman of the National Board of Electricity Supply. Mr. W. Webb, deputy engineer of the Southport Corporation, has been appointed Blackburn borough engineer, at a salary of £1250 year.

Non-ferrous Metals.

Tin has been the most interesting section of the market for non-ferrous metals during the past week, and an almost spectacular recovery has been made after the weakness of the past month. Several factors have combined to bring about this improvement, and perhaps not the least important has been the absence of bearish speculative elements; at all events, they have been less in evidence than of late. Other factors have been the publication of the January statistics which disclosed a decline in visible supplies of nearly 1000 tons, and an improvement in trade buying, more particularly on American account. The net result at the time of writing has been an improvement since my last report of nearly £10 per ton to £305 in the case of cash metal, with an advance in the three months' position of over £5 to £295 10s. This improvement, however, has not spread to copper, lead and spelter, all of which are lower than they were a week ago. Purchases of copper by industrial interests are still at a low ebb, and in spite of bullish month-end statistics relating to stocks of the metal in this country, prices have lost ground to the extent of about £1 10s. per ton, a depressing influence being the keen price-cutting that is going on between the Copper Export Association and independent concerns. In the case of lead the fall has not been serious, however, and the announcement of a curtailment of production to the extent of 15 per cent. by one of the leading American producers will probably have a steadying influence on this section of the market. The demand for spelter has only been moderate, and with sellers prominent current values are rather lower than they were a week ago.

Iron.

With coke supplies dear and not easy to secure, further expansion of the production of pig iron is a matter of some difficulty. The consequence is that offers of pig iron are by no means excessive, and of some makes there is actually a pronounced shortage of supplies so far as prompt or early deliveries are concerned. The further consequence is that makers are able to maintain quotations without much difficulty, in spite of the very poor flow of new business, current transactions, as before, being mainly to cover early requirements. Staffordshire and Derbyshire No. 3 foundry irons are on offer at about 93s.

per ton, delivered Manchester, and forge iron at about 80s. per ton at the furnaces. For Middlesbrough brands, prices are largely nominal in the absence of any important offers at 95s. per ton delivered, with Scotch brands ranging from 112s. 6d. to 116s. 6d., according to make, and West Coast hematite fully maintained at about 98s. per ton, delivered into this area. The demand for manufactured iron is still of a disappointing character, with Crown bars quoted at £11 15s. per ton and second qualities at £1 per ton less.

Steel.

Whilst optimism is strongly in evidence in the case of some sellers of steel, the majority of them express themselves as by no means satisfied with the way business is coming in, although most of them have no cause for anxiety as regards the next few months. In spite of market rumours of offers of cheap steel by some rollers, prices this week have kept firm, and on the whole show little change from those reported here a week ago. Joists and sections are quoted at from £7 17s. 6d. to £8 per ton delivered, tank plates at £8 17s. 6d. to £9, boiler plates at £11 10s., basic bars at £9, special acid wire billets at £12 10s., and ordinary quality at £11. The lower prices that are being asked for continental materials seem to be attracting more inquiries and a slight increase in buying has been reported this week. Continental joists are offered at about £6 2s. 6d. per ton delivered Manchester works for net cash against documents, ordinary plates at £7 2s. 6d., Siemens plates at £7 10s., steel bars at £6 2s. 6d., and billets at about £5 5s. per ton. More inquiry from the Indian market for galvanised sheets has been received, and values are slightly steadier than they have been at about £15 5s. per ton f.o.b. for 24 gauge sheets, thin sheets being in slow demand and unaltered as regards prices.

Scrap.

Buying of non-ferrous scrap metals continues on quiet lines, and the aggregate business during the past week has not been of very much weight. Prices, however, have kept fairly steady, with brass rod turnings quoted at £39 to £40 per ton, selected gun-metal scrap at about £50, clean light copper at £54 to £55, scrap lead at £26, and scrap zinc at £23 10s. per ton for graded materials and including delivery to users' works.

BARROW-IN-FURNESS.

Hematite.

Production of hematite pig iron is proceeding on a larger scale than has obtained for several years, and the output is likely to improve still further in the early future. The demand for special qualities continues good, and the price generally rules about £5 per ton for ordinary mixed Bessemer numbers. The market remains quiet and customers are still holding back further orders waiting, no doubt, to see if there will be a fall in prices. That cannot happen until there is a substantial fall in the price of fuel. Coke still keeps up at a price which does not leave much margin at the present time. A fair amount of confidence exists, notwithstanding, and there is a general impression that the requirements of customers are likely to be fairly heavy for the next year or so. The ironworks at Askam, part of the property of the Millom and Askam Iron Company, which have been idle for so many years, are likely to remain so. There is no truth in the rumour that they would, in consequence of the better condition of the iron trade, be put into blast again. The works at Millom, which are splendidly equipped and organised, are quite able to deal with all the demands at present and in the future. The Askam works were the first to have a furnace Americanised years ago, and the output was considerable for a time.

Steel.

The steel works are engaged at Barrow and Workington, and are likely to be for some time yet, but orders are needed if they are to continue through the year. There is some chance of further contracts, but, generally speaking, the market is not very bright. That does not apply to the hoop mills at Barrow, which are assured of a long period of activity.

SHEFFIELD.

(From our own Correspondent.)

Heavy Steel Trade.

THERE is now a very large output of open-hearth steel, most of which is going to meet old and accumulated business, and the furnaces will probably be able to maintain the present rate of working for some months. A disappointing feature is the manner in which fresh business is coming forward, but it is not unlikely that there will be a freer movement following a reduction in the price pig iron, as a good many buyers seem to be waiting for that. There is a restricted offering of pig iron, and, with quotations so much above the pre-stoppage level, only urgent orders are being placed. Buyers of steel billets are not finding it easy to get supplies, as the bulk of the material is being taken by the producers' own mills or associated plants.

Engineering Departments.

The heavy engineering departments could accommodate a great deal more work, but there is an amount of work in hand which, under all the circumstances, must be considered as satisfactory. The railway shops are among the busiest, and there is more armament work in hand than has been the case for some time. Shipbuilding requirements do not greatly improve, and a brightening up of this department would be very welcome. An order for a 2500-ton specially designed steamer for grain carrying on the Great Lakes of Canada has been received by Earle's shipyard, Hull. This order will find work for a large number of men, and an official of the firm states that they will have to work at high pressure to complete the order in the specified time. Similar ships have been constructed at the same shipyard.

The Lighter Trades.

Work among the lighter engineering branches and in the tool sections is irregular. Firms can be found who report that they are inundated with orders, but others are only able to work part time, that being accounted for by the brisk demand that prevails for certain special lines. The motor trade continues to be a good customer of Sheffield, and there is an active call for drill steel, particularly for export purposes. There are signs that the tool trades are reviving after the slump they experienced shortly after the settlement of the coal dispute. Except for a short period soon after the stoppage began, the tool trades maintained their production, and as there was a reduced call by the consuming trades there was a fair amount of material in stock at the end of the year. Files are now in greatly increasing demand, according to a report from one of the most important makers, and that seems to indicate an impending general improvement in the engineering trades, as the bulk of the extra work is coming from that source. The export business in tools of all sorts is being maintained fairly well, and inquiries are of a promising character. Business is brisk for good-class wire, and with the farm and gardening season approaching, it is gratifying to learn that orders for steel implements and appliances are well up to the average of recent years.

Plate and Cutlery.

The plate and cutlery trades have not yet got over the seasonal depression, but some firms have been busy on special contracts. Mappin and Webb, Ltd., have been working overtime at their Sheffield works for some months on an important series of contracts for high-quality plate and cutlery. To them has been entrusted the task of supplying the whole of the plate and cutlery furnishings for the recent London hotel improvement schemes, including the Park-lane Hotel, the Green Park Hotel, the Mayfair Hotel and the Devonshire House Restaurant. Entirely new designs, which have been registered, have been prepared for these contracts. At the moment the public sales of plate and cutlery are at a low point, and the wholesale and retail houses are buying with the greatest caution. Stocks, however, are not unduly high, and it is believed that good trade will follow what may be termed the opening of the home buying season. Foreign business is fairly satisfactory, but offers no points of outstanding interest.

Exhibitions for Workmen.

For several years the Sheffield Chamber of Commerce in conjunction with the Exhibitions Department of the Board of Trade, has arranged a series of exhibitions of foreign tools and cutlery purchased in oversea markets, from which manufacturers have been able to derive much useful information. By arrangement with the Sheffield trade technical societies the scope of these Exhibitions will be extended in future to give the workmen an opportunity of visiting them. Officials of the technical societies will have charge of the arrangements and will arrange explanatory talks. This is part of a big movement that is being developed in Sheffield to raise the status of the workers in the lighter trades of the city by giving them greater educational opportunities.

Hacksaw Blade Development.

Hacksaws, Ltd., of Sheffield, has issued particulars of its hacksaw blades made from high-speed steel, which is a new application of that material. Many difficulties were experienced in carrying out the adaptation, but they have been successfully overcome. The high-speed steel blades cost three or four times as much as the ordinary kind, but it is claimed that they last ten times as long and effect a saving in operation.

Sheffield's Coal Measures.

A belief widely held is that the coal measures around Sheffield and Barnsley are approaching exhaustion, but Professor Fearnsides, of Sheffield University, in a recent address before the Refractories Association of Great Britain, stated that there was no region in Great Britain and few in the world, where, within a radius of 100 miles, there was so much coal as there was in the Sheffield area. The best thing that could happen to the Sheffield coal industry would be that coal should be, by Act of Parliament, sold in terms of calorific values. That would mean that Sheffield coal would obtain a higher price than most others in the country. Speaking of the general supposition that the coal measures in this neighbourhood would eventually become worked out, and that the workings would drift eastward towards Doncaster area, Professor Fearnsides said that he had for a long time been trying to form an accurate estimate as to what would actually happen if that became an accomplished fact. Whatever else happened, Barnsley would continue to produce coal. There was 65ft. of coal there, 40ft. of which could be attacked and got. It tapered down to 20ft. at Doncaster, and less still as it drifted eastwards. The quality of coal appeared to diminish as the measures travelled towards the Trent.

London Engineering Business Purchased.

After negotiations extending over several months, William Foster and Co., Ltd., Wellington Foundry, Lincoln, have acquired the goodwill, stock, work in progress and all other assets of the business known as Gwynnes, trading under the name of Gwynnes Engineering Company, Ltd., at the Hammersmith Ironworks, London, makers of centrifugal pumps and other machinery. As soon as convenient the whole of the business, including a quantity of the highly specialised plant, will be transferred to Lincoln. In order that the goodwill of both Fosters and Gwynnes may be preserved, the trading of each firm will be continued under the separate respective names. It is expected that in a few months, when the new works get going, employment will be found for between 300 and 400 extra hands in Lincoln.

Water Problem Solved.

The problem which for some years has faced the Dearne Valley Water Board of getting an adequate supply of water appears to be well on the way to solution, relief having come by way of a new supply from Sheffield, which has just become available. It is being pumped into Roebuck reservoir, Jump, at the rate of 250,000 gallons per day. So far, only Wombwell, Jump and Elsecar are receiving this water, but work is proceeding, and a pipe is being laid to the Dearne Valley works at Broomhill, from where it will be pumped to Darfield, Goldthorpe and Bolton-on-Dearne. The agreement with Sheffield Corporation is for 500,000 gallons per day, but the mains will carry double that volume, and the agreement can be amended. The water gravitates from Moonshine dam, Sheffield, and 14 miles of mains have been laid in connection with the scheme, which has taken twelve months to complete.

NORTH OF ENGLAND.

(From our own Correspondent.)

Record Order for River Tees.

THE outstanding event in industrial circles in the North of England this week has been the success of the Furness Shipbuilding Company, of Haverton Hill, in securing, in face of keen American and other foreign competition, orders from American owners for three new ships to be built on the Tees. The vessels will be over 15,000 tons, and will be easily the biggest ships ever built on the river. The engines will also be built in the Tees-side area, the contract having been placed with Richardsons, Westgarth and Co. All three vessels will be built of British steel, and it is understood that the Isherwood system of bracketless framing will be adopted. It will be recalled that in the early part of last year the firm secured an order for three vessels from American owners. These vessels are now being proceeded with.

Cleveland Iron Trade.

Cleveland ironmasters are beset with many difficulties in their efforts to increase production and to meet the more pressing needs of their consumers. The chief difficulty is that of transport. At one end the collieries are held up for lack of trucks, and at the other the ironmasters are hampered and harassed through irregular and inadequate deliveries of fuel. The coke ovens are now reported to be working well, but the output is insufficient for industrial needs, and thus, although coal is down to pre-strike figures, blast-furnace coke is at least 6s. per ton dearer. This in turn makes pig iron scarce and dear. It limits the output and keeps up the price. More blast-furnaces cannot be blown in because there is not enough fuel, and those now operating cannot keep pace with the demand. Home deliveries are much in arrears all round, and it is almost impossible to buy iron for reasonably early delivery. Producers are not absolutely refusing to implement old contracts, but as these can only be executed now at a loss, there is some talk of marrying them to new contracts at current rates, which for home deliveries are:—No. 1 Cleveland foundry iron, 85s. per ton; No. 3 G.M.B., 82s. 6d.; No. 4 foundry, 81s. 6d.; and No. 4 forge, 80s. 6d. Export prices are nominally 6d. per ton more than home quotations, but there is no foreign business, as Cleveland prices are too high.

Hematite Pig Iron.

Brands of East Coast hematite are almost more scarce than Cleveland iron. There is next to no iron available for immediate sale, makers requiring all their output for consumption in their own steel works. Producers still command 90s. per ton for small lots of mixed numbers, though they are prepared to cut that figure for forward contracts.

Ironmaking Materials.

There is continued absence of new features in the foreign ore trade. Sales are difficult to make, but recent heavy imports have reduced arrears of deliveries, and renewal of negotiations for supplies may be experienced before long. Best Rubio ore is nominally 22s. per ton c.i.f. Tees. Good medium blast-furnace coke is fully 25s. per ton delivered at the works.

Manufactured Iron and Steel.

Very active conditions prevail in the manufactured iron and steel trade, and most of the manufacturers are simply pulled out for deliveries. Much shipyard work is held up for lack of material, and the steel works are operating at high pressure to meet the more urgent needs of their customers. But new orders do not come along so freely, and the official announcement that the steel makers have decided not to pass on to the consumer the extra cost involved in the increased railway rates has not served to stimulate the market, though the action of the steel makers is appreciated as an earnest of their anxiety to help forward the trade revival. Prices are unchanged.

The Coal Trade.

There is very little movement in the Northern coal export trade, and the position that all fitters have to face is still a very difficult one. Lack of orders occasionally, and shortage of wagons regularly, continue to upset fitters' arrangements, and thus while one day a particular brand of coal shows steadiness, the next, through unforeseen causes, it is forced on to the market, and to secure clearance prices fluctuate. Most of the collieries would welcome more inquiry. A few pits producing high-class fuel are well situated for the next week or two, but chiefly for small cargoes for early delivery. Forward trade still hangs fire. There is a considerable difference between foreign buyers' ideas and the prices asked on this side, and a good deal of business is going elsewhere. Germany is a keen competitor for Dutch and other orders. Offers

are met by counter offers, and it is not easy to arrange sales owing to the low prices at which foreign customers are endeavouring to cover their requirements. In some instances there is quite a shilling a ton between sellers' quotations and buyers' ideas of prices. New contracts secured this week include 70,000 tons of Northumberland and Durham steam coals for the Swedish State Railways, the major part of the Norwegian State Railways' order for 20,000 tons, 20,000 tons of Wear special gas coals for the Palermo Gasworks for shipment in four cargoes between April and October, and 15,000 tons of best steam smalls for the Danish Sugar Works. The steam coal trade is somewhat slumpy, and, with a large output, stocks are difficult to clear, despite low values. Best qualities are only in moderate demand, mainly through second hands at 16s. 6d., but fitters continue to hold for 17s. Best Durham steams are 18s. to 19s., and other classes 15s. 6d. to 16s. For small steams the position remains very disappointing. Best Northumberlands are 10s.; specials, 11s.; and ordinary, 10s. 3d. Durham gas coals, while not in brisk demand, are moving fairly steadily, and values are maintained; best kinds being 17s. to 18s., and secondary 15s. 6d. to 16s. 3d. After a busy few weeks coking coals have gone dead flat, and while sellers hold to 16s. 6d. to 17s., they find very little business obtainable. Both the home and export demand for coke is brisk, and stocks are very low. Gas coke rules firm at 23s. to 23s. 6d. Patent foundry cokes are quiet, and production is ample for requirements at 23s. to 26s.

Ironstone Mechanics' Wages.

The wages of mechanics at the Cleveland ironstone mines were under discussion at a conference at Middlesbrough on Wednesday of representatives of the mineowners and the Miners' Association. Although the matter was discussed at length, no settlement was reached, the meeting being adjourned to enable both sides to make inquiries at the mines. The men's claim for an increase will be further considered at a later meeting on a date to be fixed.

SCOTLAND.

(From our own Correspondent.)

Lack of New Business.

SPEAKING generally, no improvement can be recorded in the steel, iron and coal trades. Some departments are in a better position than others, owing mainly to an accumulation of orders during the coal strike, but those sections in need of fresh business are going very slowly. Conditions might, of course, have been better already, had it not been for the uncertainty in the East, and also, perhaps, in a minor degree, to the imposition of higher railway rates.

Pig Iron.

The pig iron market is very quiet. The number of furnaces in blast remains at twenty, and supplies of foundry makes in particular are restricted. Demands, however, are confined to immediate requirements, as buyers consider prices too high. Supplies of hematite are equal to all present needs.

Steel.

Buyers of steel likewise await a reduction in prices, an attitude which is strengthened by keener foreign competition. In the meantime, most of the works are busy on old contracts. Shipbuilders are pressing for deliveries of plates and sections, and works engaged on these materials are very active. The demand for steel sheets continues. Light sheets are more in evidence than heavy descriptions at the moment, and the higher grades of the former are very well placed, both in black and galvanised descriptions. Prices are somewhat easier, owing to cheaper costs of spelter and other raw materials.

Iron.

Reports to date indicate a slight improvement in the demand for bar iron. The level of prices remains high, however, and a substantial increase in turnover is not anticipated at the moment. The re-rolled steel departments are not now so active as they were a few weeks ago, and prices have weakened. The present quotation is in the region of £8 10s. per ton.

Coal: Export Inactive.

Conditions in the coal trade can hardly be termed satisfactory. Home demands for industrial fuels are somewhat better, and household grades are busier, but business is still hampered by the presence of considerable quantities of American fuel, contracted for by railway companies and gasworks. Supplies of most qualities of fuel are fairly ample, and the restricted business in round coal is causing a shortage in washed materials, and these maintain a firm tone. Inquiries from abroad are not resulting in much business, and only the slight increase in home demands prevents a further fall in prices. Lanarkshire ells and Fifeshire steams present the firm spots in the market meantime so far as round fuel is concerned, while treble nuts, especially in Fifeshire, are very steady. Aggregate shipments amounted to 232,235 tons against 215,117 tons in the preceding week and 239,219 tons in the same week last year.

Foreign Coal at Glasgow.

The import of foreign coal into Glasgow has now practically ceased. From the beginning of the coal strike until the end of January last, over 900,000 tons of coal arrived at Glasgow. First cargoes came from the Continent, but since the end of September no continental coal was imported. It is anticipated that the last of the foreign fuel will be discharged by the end of the present week.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THERE has not been a great deal of alteration in the state of the coal trade during the past week, as compared with the conditions formerly prevailing. Business is slightly more active, but it is insufficient to have any real effect upon the market generally. Prices are a shade lower, but must be getting to rock-bottom, as there is a limit to which coalowners can go in their endeavours to induce foreign consumers to operate. The unfortunate part of making concessions to those buyers who can ship immediately and thus provide collieries with empty wagons, so as to prevent stoppages of work at the pits, is that these reduced prices more often than not become the basis of sales for later positions. As has frequently happened in the past, coalowners have found that reductions in quotations do not bring any real compensation in the way of increased business. The demand from abroad is comparatively quiet, and it would seem that notwithstanding the long stoppage of the coal industry in this country production of coals throughout the world is greater than the needs. There must be a world improvement in industry in general to absorb outputs and establish prices on a basis which will be really remunerative for coalowners. Operations at the present time are in the main on a hand-to-mouth basis. Few foreign consumers are apparently prepared to buy ahead. There are, of course, inquiries for supplies over the remaining part of this year, but the prices that are indicated are not at all attractive, as they are in most instances about 1s. per ton below the current market values, which are considered to be low. Tenders have shortly to go in for 30,000 tons of steam coals for the Norte Railways of Spain, while the Algerian State Railways are in the market for 60,000 tons of patent fuel for delivery over six months or for a proportionately larger quantity for delivery over twelve months. In both cases prices have to be submitted on a c.i.f. basis.

Tonnage Question.

For the past two or three weeks the tonnage position has not been a very satisfactory one for the collieries. Bad weather has prevented steamers coming along when they were expected, and this has had the effect of dislocating the arrangements of collieries. At the present time the supply is quite inadequate, and there is a demand for boats with prompt readiness. The quantity of tonnage available is an all-important factor in business in the coal export trade. Many people who are not closely acquainted with the trade do not realise the value of the middleman and his enterprise in obtaining business, but he has to take enormous risks. A very large proportion of the coal business is done on a c.i.f. basis, and it does not follow, because a firm which may or may not be associated with colliery interests has taken a big contract, that it is going to make a substantial profit. While coal values may fall, thus enabling it to secure its supplies on a lower basis than it had calculated upon, it is quite possible that this advantage may be more than neutralised by a rise in freight rates. This has happened recently. So much tonnage is being sent westward, owing to the attractive business on offer from South American ports, that merchants with business for Upper Mediterranean ports are having an anxious time. The market for ports like Port Said and Alexandria has appreciated beyond all expectations, and freight rates have advanced round about 4s. per ton, as compared with a few weeks ago. The rate for Port Said is now about 14s., which is the highest figure touched since 1923, in which year the top rate was 15s.

Docks Working Hours.

Reports to hand are that the new working conditions at the docks, under the split-shift system, are operating fairly smoothly. Exactly the same hours are not being worked at all the ports by the trimmers and tippers. For instance, at Swansea a satisfactory arrangement has been come to by which the day shift is from 8 a.m. to 5 p.m., and the night shift from 9 p.m. to 6 a.m., compared with 7 a.m. to 4 p.m. and 8.30 p.m. to 5.30 a.m. for the day and night shift respectively at Cardiff, Penarth and Barry. At Newport there has been a certain amount of dissatisfaction on the part of the workmen with the new conditions, but conferences have been taking place between the representatives of the trimmers and the employing interests, and it looks as if during the current week all difficulties will be overcome.

Colliery Dispute.

Owing to a dispute between the management and the hauliers on the question of payment rates, work at the three collieries belonging to the Gwaun-cae-Gurwen Company in the anthracite area has been at a standstill since the latter part of last week. About 2000 men are affected. There is, however, to be a meeting of the Standing Joint Disputes Committee on Thursday of this week, and it is hoped that before long an arrangement will be come to which will enable an early resumption of work to take place.

New Miners' Union.

The first conference promoted by the new miners' union in this district was held at Pontypridd on Monday, when Mr. Charles Goodin, of Ynysddu, was elected by the delegates as chairman. The proceedings showed that the promoters are imbued with a very different spirit to that which has been displayed at other gatherings of miners, as will be appreciated from the fact that one of the speakers stated that they realised that they could only get from any industry what they put into it, and consequently it was their duty to produce and then claim and demand a fair share for the labour they had given. Another speaker remarked that the directors of leading companies in South Wales had within the last ten days made statements to the effect that if they would only get the new union going and imbue the men with the right spirit, and leave suspicion out of it, they would be prepared to consider the question of division of profits. The new union, which is to be called the South Wales Miners' Industrial Union, is to be absolutely non-political, and not a single penny will be given to funds for political purposes.

Coal Contract.

It is reported that a leading coal undertaking at Cardiff has concluded a contract for the transport of about 100,000 tons of Welsh coal to Buenos Aires or La Plata from May to December at 15s. 6d. per ton. This contract for the supply of coals represents business which has been recaptured from the Germans.

New Steamship Line.

The Elder Dempster Line has decided to inaugurate a new cargo steamship service between South Wales and the principal ports of West Africa. This new service will commence with the sailing from Cardiff on Sunday, February 20th, of the 6500-ton new liner New Columbia, which will be followed two months later by another of the line's modern steamers. This company, which has already offices at Cardiff, is building a new block of offices in the heart of Cardiff's coal commercial centre, viz., Mount-stuart-square, the cost of which is to be £60,000.

New Fuel Works.

It is announced that the Star Patent Fuel Company, Ltd., has leased about two acres of land with 450ft. of quay space on the west side of the Roath Basin, Cardiff, for the purpose of erecting a new patent fuel works. The Great Western Railway Company, to which the land belongs, has commenced clearing the site in readiness for the new works. The Star Company already has works on the Glamorgan Canal side at Blackweir, near Cardiff, which necessitates the fuel being barged down the canal to the docks for shipment.

Current Business.

The tone of the steam coal market is still comparatively quiet, although there is slightly more business about. This, however, does not apply to all descriptions, as dry qualities are in slow demand, while Monmouthshire descriptions are rather in request. On the whole, prices display no material alteration. The small coal section is relatively the steadiest department, as, owing to the fairly numerous pit stoppages, the supply has been curtailed. Patent fuel is in moderate demand at a shade lower level, while pitwood is slightly firmer.

ZINC SPECIFICATIONS.

THE British Engineering Standards Association has just published three British Standard Specifications for different qualities of zinc, namely:—No. 220, 1926, Fine zinc (or spelter), (Grades A and B); No. 221, 1926, Special zinc (or spelter); No. 222, 1926, Foundry zinc (or spelter).

The percentages of zinc in the two "fine" grades are specified as 99·95 per cent. minimum and 99·90 per cent. minimum respectively; for special zinc the minimum zinc content is 99·50 per cent. and for foundry zinc 98·50 per cent. The specifications include particulars as to how the samples are to be taken for analysis, both as regards the means to be used and also the positions in the plates from which the samples are to be extracted.

Copies of these three new specifications (Nos. 220, 221 and 222) can be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, S.W. 1, price 2s. 2d. each, post free.

LAUNCHES AND TRIAL TRIPS.

APAPA, motor passenger liner; built by Harland and Wolff Ltd.; built to the order of Elder, Dempster and Co., Ltd.; dimensions, 468ft. 9in. by 62ft. by 35ft.; 9333 gross tonnage. Engines, two six-cylinder, four-cycle, double-acting Diesel; constructed by the builders; trial trip, January 28th.

KINLOCH, steamer; built by Swan, Hunter and Wigham Richardson, Ltd.; to the order of the Valley Camp Coal Company, Ltd., for service on the Great Lakes of North America; dimensions, 260ft. long by 43ft. beam; 2000 tons deadweight. Engines, triple-expansion; constructed by the builders; launch, February 1st.

CATALOGUES.

NEWMAN, HENDER AND CO., Ltd., Woodchester, Glos.—1926 edition of the firm's general catalogue of valves, cocks, gauges, and general steam and water fittings.

POTT, CASSELS AND WILLIAMSON, Motherwell.—List No. 89, entitled "Some Notes on the Application of Electric Motors to the Driving of Centrifugal Machines."

PARSONS OIL ENGINE COMPANY, Ltd., Town Quay Works, Southampton.—Publication No. 89, giving particulars and prices of Parsons electrically driven pumps.

THE HAMWORTHY ENGINEERING COMPANY, Ltd., 76, Victoria-street, S.W. 1.—Illustrated catalogue of petrol-paraffin engines in various sizes from 2½ to 18 brake horse-power.

LAFARGE ALUMINOUS CEMENT COMPANY, Ltd., 296, High Holborn, W.C. 1.—A booklet entitled "Evidence," containing letters from a large number of users of "Ciment Fondu."

THE OIL WELL ENGINEERING COMPANY, Ltd., Cheadle Heath, Stockport.—General catalogue No. 26, a leather-bound book of over 800 pages, dealing with all types of oil well machinery.

R. A. SKELTON AND CO., Moorgate Station Chambers, Moorfields, E.C. 2.—Handbook No. 19, entitled "Structural Steel," giving the sizes, weights, code words, extras, tests, &c. Price 5s. net.

J. DICKINSON AND CO. (BOLTON), Ltd., Fairclough-street, Bolton.—Descriptive leaflet of the "Trial Outfit" of rock asphalt, &c., and its uses for repairing floors of industrial premises.

TELEGRAPH CONDENSER COMPANY, Ltd., Norwich House, Southampton-street, W.C. 1.—Catalogue No. 51, dealing in detail with the "T.C.C." oil-immersed static condenser for power factor improvemet.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 10 0	—
No. 1 Foundry	4 15 0 to 4 17 6	—
No. 3 Foundry	4 11 6 to 4 14 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 10 0	4 10 0
No. 1	4 11 0	4 11 0
Cleveland—		
No. 1	4 5 0	4 5 6
Silicious Iron	4 5 0	4 5 6
No. 3 G.M.B.	4 2 6	4 3 0
No. 4 Foundry	4 1 6	4 2 0
No. 4 Forge	4 0 6	4 1 0
Mottled	4 0 0	4 0 6
White	4 0 0	4 0 6
Midlands—		
(2) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	4 0 0	—
„ „ Foundry	4 7 6	—
(2) Northampton—		
Foundry No. 3	4 0 0 to 4 2 6	
„ Forge	3 13 0	—
(2) Derbyshire—		
No. 3 Foundry	4 2 6 to 4 5 0	
Forge	3 18 0	—
(2) Lincolnshire—		
No. 3 Foundry	4 5 0	—
No. 4 Forge	—	—
Basic	3 17 0 to 3 18 0	
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 17 6 (a) .. / 5 0 6 (b) .. / 5 4 0 (c) ..	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	11 15 0	—
Best	—	—
N.E. Coast—		
Common Bars	12 5 0	—
Lancs.—		
Crown Bars	11 15 0	—
Second Quality Bars	10 15 0	—
Hoops	14 0 0	—
S. Yorks.—		
Crown Bars	12 10 0	—
Best Bars	13 10 0	—
Hoops	14 10 0	—
Midlands—		
Crown Bars	12 5 0	—
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	11 0 0	—
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	11 0 0	—
Ship Plates, ½in. and up	8 7 6	—
Sections	7 17 6	—
Steel Sheets, under 3/16in. to ½in.	12 5 0 to 13 5 0	
Sheets (Gal. Cor. 24 B.G.)	—	£16 0 0 to 17 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 10 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0†.. ..	—
Light Rails	8 15 0 to 9 0 0	
Billets	8 0 0 to 11 10 0†	
Manchester—		
Bars (Round)	9 0 0	—
„ (Small Round)	9 0 0	—
Hoops (Baling)	11 0 0	11 0 0
„ (Soft Steel)	10 15 0	10 15 0
Plates	8 17 6 to 9 0 0	
„ (Lancs. Boiler)	11 10 0	—
Sheffield—		
Siemens Acid Billets	11 0 0	—
Bessemer Billets	11 0 0	—
Hard Basic	9 2 6	—
Intermediate Basic	8 12 6	—
Soft Basic	7 15 0 to 8 0 0	
Hoops	12 0 0	—
Soft Wire Rods	10 0 0	—
Midlands—		
Small Rolled Bars	8 15 0 to 9 0 0	
Billets and Sheet Bars	7 0 0 to 7 5 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	15 10 0	—
Angles	7 17 6 to 8 0 0	
Joists	7 17 6 to 8 0 0	
Tees	9 0 0	—
Bridge and Tank Plates	8 17 6 to 9 2 6	
Boiler Plates	11 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	19/9 to 20/3
Block Tin (cash)	305 0 0
„ (three months)	295 10 0
Copper (cash)	53 0 0
„ (three months)	53 10 0
Spanish Lead (cash)	26 7 6
„ (three months)	26 17 6
Spelter (cash)	29 0 0
„ (three months)	29 5 0
Manchester—	
Copper, Best Selected Ingots	60 10 0
„ Electrolytic	60 12 6
„ Strong Sheets	86 0 0
„ Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price) lb.	0 11½
„ Condenser lb.	0 1 1½
Lead, English	28 10 0
„ Foreign	27 10 0
Spelter	29 15 0
Aluminium (per ton)	£107

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
„ „ 6 p.c. to 8 p.c. „	£22 0 0	7/3
„ „ 8 p.c. to 10 p.c. „	£20 17 0	6/6
„ „ Specially Refined		
„ „Max. 2 p.c. carbon	£36 2 6	11/6
„ „ „ 1 p.c. „	£42 5 0	15/-
„ „ „ 0·70 p.c. carbon	£54 0 0	17/6
„ „ „ carbon free	1/5d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£16 for home, £16 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 7 6 scale 5/- per unit	
„ „ 75 p.c.	£18 10 0 scale 6/- per unit	
„ Vanadium	14/6 per lb.	
„ Molybdenum	5/1 per lb.	
„ Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Cobalt	8/6 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable*).

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	16/6
„ „ Ell	17/9
„ „ Splint	18/- to 21/-
„ „ Trebles	20/-
„ „ Doubles	18/3
„ „ Singles	17/3
Ayrshire—	
(f.o.b. Ports)—Steam	17/6
„ „ Jewel	19/-
„ „ Trebles	20/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	14/- to 15/9
Screened Navigation	22/9
Trebles	20/- to 23/-
Doubles	17/6 to 18/-
Singles	15/9
Lothians—	
(f.o.b. Leith)—Best Steam	15/6
Secondary Steam	15/-
Trebles	20/-
Doubles	18/-
Singles	15/6

ENGLAND.

(3) N.W. Coast—	
Steams	27/6
Household	*No quotation*
Coke	31/6
Northumberland—	
Best Steams	16/6 to 17/-
Second Steams	15/6 to 16/-
Steam Smalls	11/-
Unscreened	15/6 to 16/-
Household	23/- to 30/-
Durham—	
Best Gas	17/- to 18/-
Second	15/6 to 16/-
Household	23/- to 30/-
Foundry Coke	24/- to 25/-
Sheffield—	Inland.
Best Hand-picked Branch	40/- —
Best Selected House Coal	34/- to 35/- —
Barnsley Best Silkstone	30/- to 32/- —
Derbyshire Best Brights	30/- to 32/- —
„ „ House	26/- to 30/- —
„ „ Large Nuts	26/- to 28/- —
„ „ Small	18/- to 21/- —
Yorkshire Hards	19/- to 21/- —
Derbyshire Hards	19/- to 21/- —
Rough Slacks	12/- to 12/6 —
Nutty Slacks	8/6 to 9/6 —
Smalls	3/- to 6/- —
Blast-furnace Coke (Inland)	20/- to 25/- at ovens.*
„ „ (Export) f.o.b.	26/- to 27/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals :	
Best Smokeless Large	22/6 to 23/6
Second „ „	22/- to 22/6
Best Dry Large	22/6 to 23/-
Ordinary Dry Large	20/6 to 21/6
Best Black Vein Large	22/- to 22/6
Western Valley Large	21/6 to 22/-
Best Eastern Valley Large	21/- to 21/6
Ordinary „ „	20/6 to 21/-
Best Steam Smalls	14/6 to 15/6
Ordinary „	11/- to 14/-
Washed Nuts	20/- to 26/6
No. 3 Rhondda Large	28/- to 29/6
„ „ Smalls	18/- to 19/-
No. 2 „ Large	21/- to 22/-
„ „ Through	18/- to 19/-
„ „ Smalls	13/- to 14/-
Foundry Coke (export)	40/- to 50/-
Furnace Coke (export)	27/6 to 30/-
Patent Fuel	27/6 to 28/-
Pitwood (ex ship)	30/- to 32/-
Swansea—	
Anthracite Coals :	
Best Big Vein Large	32/6 to 35/-
Seconds	30/- to 32/6
Red Vein	27/6 to 29/-
Machine-made Cobbles	42/6 to 45/-
Nuts	50/- to 57/6
Beans	44/- to 46/-
Peas	22/6 to 25/-
Breaker Duff	9/- to 9/6
Rubbly Culm	13/9 to 14/3
Steam Coals :	
Large	22/6 to 24/-
Seconds	22/- to 22/6
Smalls	10/- to 12,6
Cargo Through	17/6 to 19/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. † Latest quotations available.

(a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. * Open market price. Special price for pig iron producers, 19/- per ton at ovens.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Slump.

THE franc has remained at its present level for a relatively long period, and that has inspired a belief in an early recovery, which is strengthened by the conviction that, as stocks of all kinds are being depleted, there must soon be a resumption of buying in order to replenish them. There is, unfortunately, at present no real justification for such a belief. No one thinks of replenishing stocks, and business is at a standstill. Production is slowing down more and more, and unemployment is increasing every week, while nothing has been done yet to put in hand the public works which are declared to be urgently necessary to cope with the situation. Notwithstanding the high cost of pig iron, and the small concessions which coal-owners have been induced to make under official pressure, rolled iron and steel prices have been falling until they appear to have reached a point at which any further reduction will be difficult unless much cheaper supplies of coal are available. Merchant bars are down to 600f. and 620f. a ton. Four months ago the export price in Brussels was £6 a ton, and during the past week or two it has fallen from £5 2s. to £4 17s. a ton. The absence of demand and the decline in prices are naturally suggesting whether the Cartel will be induced to limit still further the steel production, and in view of the attitude of German steelmakers, who are claiming a larger quota, there is a good deal of nervousness as to the future of the combine, which many believe is passing through a rather critical period. It is certain that the idea of creating the Cartel was based largely upon political considerations, and now that the Germans see that they have not secured the political concessions they expected, there are threats of withdrawal, while many German steelmakers feel that the unexpected slump in trade has placed them in an adverse position. In this country the German threats are regarded merely as another attempt to force the hands of the French, who have no intention of changing the terms of the agreement, and they affirm that, in the highly improbable event of the Germans withdrawing, the French steelmakers will be quite able to hold their own in open competition. In the engineering branches the situation has rarely been so bad as it is now, and work is becoming increasingly scarce, largely because it is impossible to submit lower tenders while production costs remain practically unchanged, and as the value of the franc has increased the tenders are really higher at a time when everyone is looking for a reduction in prices. Some of the shipbuilders are being provided with work under the programme of naval construction, and the railway companies have been distributing a fair number of orders for rolling stock.

The Battleship France.

The Government has made several attempts to arrange for the salving of the 23,500-ton battleship France, which struck an uncharted rock and sank in the Teignouse Passage, between Belle Ile and Quiberon, on July 30th, 1923. As further tenders have been postponed recently, it is assumed that negotiations are proceeding privately. The vessel is completely submerged except at low water, when the bows are awash. It has been examined by British and French divers, who declare that the ship is lying on a smooth rock and that there is an irregular breach extending from the bows for about 200ft.

A New Cruiser Type.

The Senatorial Commission of the Marine has requested the Government to prepare plans of a new type of *croiseur d'escort*, which has to combine speed, range of action and armament in a way that will make it superior to anything of the kind in the French Navy, and which is, obviously, intended to act as convoy for transport and merchant vessels. It must have a displacement of between 7500 tons and 8000 tons, and with a range of action of 5000 miles, it must be capable of steaming at a minimum of 25 knots. Steam will be raised by oil fuel. The armament will consist of six 203 mm. guns in double turrets, four 75 mm. guns, and two anti-aircraft guns of 40 mm., together with eight machine guns and two triple 550 mm. torpedo tubes. The ship will carry two seaplanes, and will have accommodation for 140 aspirants or cadets.

Rail Motors.

After an extended experience with rail motors for shunting and other purposes, the railway companies are putting an increasing number of these vehicles in service, and it appears as if the internal combustion engine will occupy a much more important position on the railways in the future. The chief advantage of the petrol shunting engine is its handiness and readiness for taking away coaches from the platforms at the termini, where the accommodation is so limited that coaches cannot be allowed to remain in the stations for a longer time than is necessary. The petrol engine can be left at any convenient spot until wanted, while the steam shunting locomotive must be sent for from the sheds often a considerable distance away. The shunting vehicles have engines of about 100 horse power, and will pull out loads from the platforms of about 800 tons. Their chief requirement is flexibility in starting under load, which is ensured by means of slipping clutches. There is a lighter type of rail motor known as the *draisienne*, which is usually propelled by a 40 horse power engine, and is required to haul loads up to about 80 tons. There are half a dozen firms building these vehicles, and they have all orders in hand for the railway companies. A still lighter vehicle is now being designed with a 7 horse power engine for track inspection and for rail laying, and it is expected that a considerable number of these motors will be in service before long. The same progress does not appear to be made with rail motors for passenger traffic on local lines, for while it is argued that such lines can only be made to pay by suppressing steam locomotives it is by no means certain that they will be replaced by petrol motors. It is generally expected that engines with charcoal suction gas equipment will successfully meet the requirements of the railway companies.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

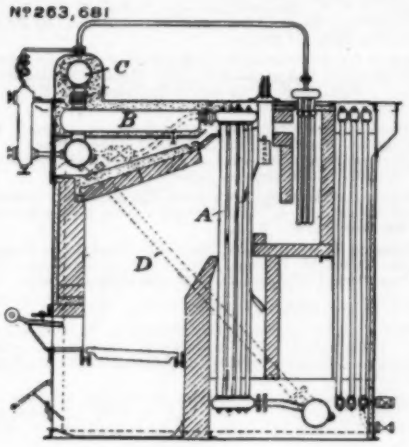
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

263,681. June 29th, 1926.—HIGH-PRESSURE BOILERS, C. Duquenne, Villemomble, France.

The inventor explains in this specification that difficulties arise in connection with the working of high-pressure—say, 200 atmospheres—boilers on account of the similarity of the densities of steam and water and their consequent reluctance to separate. To this end, there are interposed between the separate water and steam drums and the upper headers,



horizontally disposed tubular drums which receive the whole of the water and steam emulsion produced in the vaporising elements, and which act as separators for this emulsion, owing to the large separation surfaces and to the lengthening of the path travelled by the emulsion. In the drawing, the vaporising elements are shown at A and the horizontal drums, just referred to, at B. C is the main steam drum and D is a down-comer.—*January 6th*, 1927.

CONDENSERS AND FEED-WATER HEATERS.

263,617. December 16th, 1925.—FEED WATER MAKE-UP CONTROL, H. Fothergill and H. Hillier, 3, Central-buildings, Westminster.

This mechanism is intended for the control of the feed-water system of a condensing plant by means of a single float, in such a manner that any make-up water is automatically sent into the condenser and there de-aerated, while an excess of water coming momentarily from the condenser is diverted to the feed tank. The mechanism is illustrated in Fig. 1, and the piping arrange-

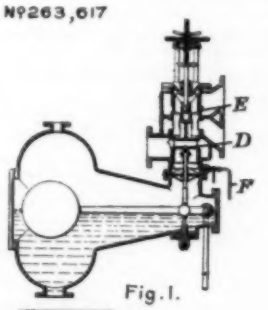


Fig. 1.

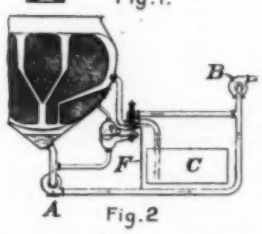


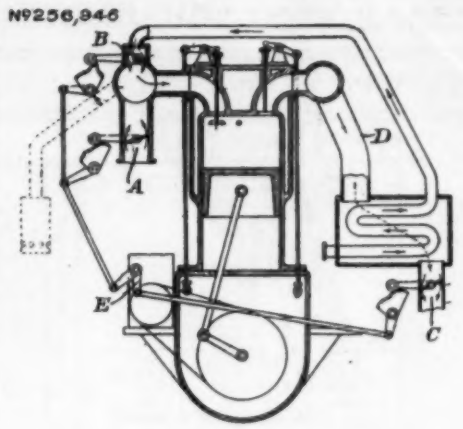
Fig. 2

ment in Fig. 2, which indicates the condensate extraction pump at A, the feed pump at B and the feed tank at C. The control comprises a float and chamber connected with the condenser space, which works a needle valve D in the bottom of the cylinder of a piston valve E. The needle valve determines the pressure of water supplied under the piston valve by way of the pipe F and consequently the position of the piston valve, which controls the flow of the feed water in the desired manner.—*January 6th*, 1927.

INTERNAL COMBUSTION ENGINES.

256,946. July 28th, 1926.—CONSTANT PRESSURE INTERNAL COMBUSTION ENGINES, Société Anonyme Adolphe Saurer, Arbon, Switzerland.

This invention is concerned with the trouble, generally experienced with heavy oil engines, of "gumming up" when they are run on light load for any extended period. Accordingly as the fuel admission is changed, the suction temperature is increased, the quantity of suction air is reduced, and the exhaust gases are throttled, these measures being employed conjointly for increasing the mean temperature in the combustion space of the cylinder. The desired result may also be obtained by increasing the suction temperature by preheating the suction air, and

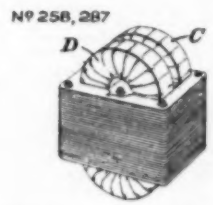


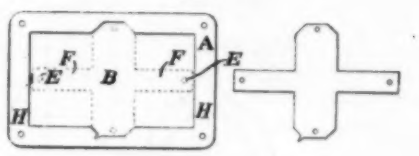
simultaneously reducing the quantity of suction air by throttling. In the drawing, the several throttling controls are shown at—A, the cold air admission; B, the hot air admission; and C, the cold air to the heater warmed by the exhaust gases from the pipe D. These controls are all operated by cams and linkage connected with the fuel pump E, as shown.—*January 6th*, 1927.

TRANSFORMERS AND CONVERTERS.

258,287. September 13th, 1926.—IMPROVEMENTS IN AND RELATING TO TRANSFORMERS, *The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C.* 2.

In this specification is described a high reactance transformer, so designed as to limit the current supplied by the secondary winding to a safe value. The reactance increases with the leakage magnetic flux, and the main object of the invention is to give the transformer a high leakage flux and reactance. The core consists of an outer element A and an inner element B, and the primary and secondary windings C and D are assembled as shown in the upper drawing. Thin non-magnetic air gaps



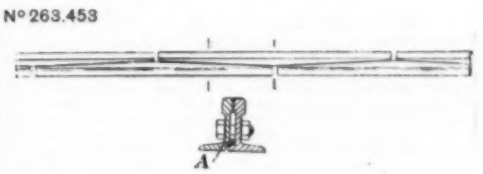


are provided at the points E between the outer ends of the side extensions F, and the adjacent inner faces of the outer legs of the core, the extensions F and the air gaps E providing shunt paths for leakage flux. In order that the transformer may have high reactance, the reluctance of these shunt paths must be low, and for very high reactance it is desirable that the air gaps E be very thin to avoid the necessity of unduly large cross-section in the extensions F. High-reactance transformers constructed in accordance with this invention are useful for operating bells, electric toys, high-voltage testing apparatus, spark plugs for igniting the oil vapour in oil heaters, and for various other purposes.—*January 6th*, 1927.

TRAMWAYS AND RAILWAYS.

263,453. September 14th, 1926.—RAILWAY RAILS, F. C. McLean, 48, Clarence-street, Hamilton, New Zealand, and J. Pickard, 50, Clarence-street, Hamilton.

Had this specification included a description of the process of manufacture it involves, it would have been much more interest.



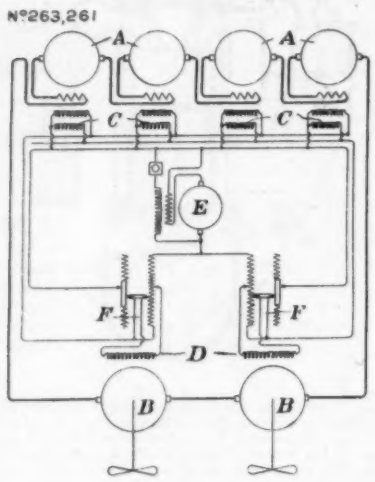
ing. As it stands it amounts to a claim for a series of rails split longitudinally, tapered edgeways, and bolted together with staggered joints. The vertical stiffness of the rail is assisted by the lug shown at A in the cross-section.—*December 30th*, 1926.

SHIPS AND BOATS.

263,261. October 26th, 1925.—IMPROVEMENTS IN AND RELATING TO SYSTEMS OF SHIP PROPULSION, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2; Frederick Horton Clough, of Kilsby, Northampton; and Allan Adair Pollock, of "Croxton House," Sherborn-place, Leamington Spa, Warwick.

According to this invention the direction of rotation and speed of the propellers is controlled by varying the direction and magnitude of the current in the fields of the motors, as in the case of the series constant current scheme referred to in patent No. 226,960. In the present case, however, the excitation current

of the generators is increased proportionately with the motor field current, so that, as the motor field strength is increased, the voltage of the system increases and thereby the current is increased so that the torque delivered by the motors varies approximately as the square of the change in the field current. This characteristic is very suitable for driving propellers, as it is a well-known fact that the torque taken by a propeller varies in proportion to the square of the speed. The four generators are shown having their armatures A connected in series with the

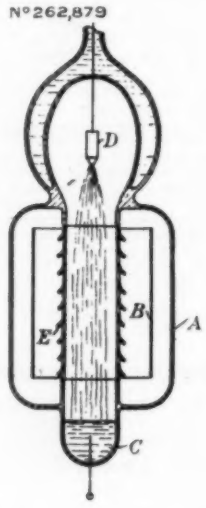


armatures B of two propeller motors. The generator fields C and the motor fields D are excited by means of an exciter E, and the generators are excited in proportion to the motor fields by connecting the generator fields C in series with potentiometer rheostats F controlling the motor fields D. In such a case matters may be arranged so that a certain fixed excitation may first be applied to the motors without producing any current in the generator fields. An alternative arrangement is described. —*December 30th*, 1926.

MISCELLANEOUS.

262,879. September 24th, 1925.—IMPROVEMENTS IN OR RELATING TO ELECTRON DISCHARGE TUBES, Siemens Schuckertwerke Gesellschaft mit beschrankter Haftung, of Berlin-Siemensstadt, Germany, and Rudolph Gottfried Berthold, of 50, Rohrdamm, Berlin, Siemensstadt, Germany.

The object of this invention is to produce an electron tube with means for controlling the anode current, which enables far greater currents to be dealt with than usual, and which renders possible good control of the anode. One example of the invention is shown where A is the glass container of the electron tube, with a cylindrically shaped anode B, the cathode of the tube being formed by an arc along the centre of the tube. To generate the arc a mercury cathode C is provided in the lower portion of the tube and a special anode D is the upper portion. The arc can be maintained by connecting the cathode C and the arc anode D to an auxiliary voltage. On applying a suitable



pressure between the arc and anode B, the electrons issue in precisely the same manner as in an incandescent cathode from the arc to the anode B, but the current strength is very much greater than usual. In order to prevent the passage of gas particles from the arc to the anode B, the arc is surrounded with a mantle E, which is perforated on its circumference, the edges of the perforations being turned upwards, as shown. The arc gases streaming from the mercury cathode C to the arc anode D therefore exercise a suctional effect on the gases in the interior of the anode B, and carry them off to the anode. The space surrounding the arc anode is cooled with the aid of a cooling device, so that the mercury gases are condensed. Moreover, the gases in the vicinity of the arc anode can always be sucked up, thereby increasing the vacuum in the tube itself. The mantle E around the arc can be used simultaneously if the tube is controlled electrically. There are four other illustrations.—*December 23rd*, 1926.

THE BRITISH ELECTRICAL AND ALLIED INDUSTRIES RESEARCH ASSOCIATION.—The sixth annual report issued by this Association shows that during the past year much important research work was undertaken, and a brief account of that work was given in our annual article on Electrical Engineering in 1926. Many branches of the electrical and kindred industries were catered for. The report covers, for instance, researches on dielectrics of many kinds, conductors, electric control apparatus, steam and steam turbines, telephone interference, magnetic materials, instrument springs, primary cells, &c.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

ELECTROMOBILE ASSOCIATION.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Informal meeting. Discussion on "The Use of Storage Battery Type Electromobiles," to be opened by Mr. J. C. Elvy. 7 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Applied Science Department of the University, St. George's-square, Sheffield. "Bronze," by Mr. R. T. Rolfe. 7.30 p.m.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—Metallurgical Department of the University, Singleton Park, Swansea. "The Design of Annealing Furnaces," by Mr. J. S. Caswell. 7.15 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND STUDENTS' SECTION.—Visit to the Witton destructor works. 7.15 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Honorary members' lecture, "The Physiology of Work under High Air Temperature Conditions," by Professor K. Neville Moss. 7.30 p.m.

NORTH-EAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Literary and Philosophical Society's Rooms, Newcastle-upon-Tyne. "Psychology as an Aid to Efficiency and Economy in Industry," by Professor F. Smith. 6 p.m.

PHYSICAL SOCIETY.—Imperial College of Science, South Kensington, London, S.W. 7. Annual general meeting. Presidental address, "The Present State of Atomic Physics," by Professor O. W. Richardson. 5 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "Old Hampton Court Palace Revealed," by Mr. Ernest Law. 9 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—Room 24, Royal Technical College, George-street, Glasgow. Paper, "Silica Brick," by Messrs. A. H. Middleton and C. Bride. 7 p.m.

MONDAY, FEBRUARY 14TH.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—Institution of Engineers and Shipbuilders, 39, Elmbank-crescent, Glasgow. "Notes on Aluminium Alloys," by Mr. D. R. Tullis. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: BIRMINGHAM CENTRE.—Chamber of Commerce, New-street, Birmingham. Paper, "The Straight-eight Engine," by Mr. E. W. Sisman. 7 p.m.

ROYAL SOCIETY OF ARTS.—14, John-street, Adelphi, London, W.C. 2. Cantor Lecture, "Photo-elastic Measurements of Stress Distribution," by Professor E. G. Coker. 8 p.m.

TUESDAY, FEBRUARY 15TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, BURNLEY SECTION.—Municipal College, Ormerod-road, Burnley. Paper, "Strickle Moulding from the Spindle," by Mr. L. Wharton. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Coventry Graduates' meeting. Paper, "The Problem of Selling Cars," by Mr. A. E. L. Collins. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: WOLVERHAMPTON CENTRE.—Engineering and Scientific Club, Queen-street, Wolverhampton. Paper, "The Supercharging of Aircraft and Motor Vehicle Engines," by Mr. A. H. R. Fedden. 7.30 p.m.

WEDNESDAY, FEBRUARY 16TH.

CHAMBER OF SHIPPING OF THE UNITED KINGDOM.—Hotel Victoria, Northumberland-avenue, London, W.C. 2. Annual Dinner. 6.30 for 7 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Mappin Hall of the University, Sheffield. "The Application of X-rays to the Examination of Metals," by Dr. V. E. Pullin. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Chamber of Commerce, New-street, Birmingham. Birmingham Graduates' meeting. Paper, "The Problem of Selling Cars," by Mr. A. E. L. Collins. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—The Engineers' Club, Albert-square, Manchester. Paper, "The Straight-eight Engine," by Mr. E. W. Sisman. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Students' meeting. Paper, "Some Considerations of our Power Resources," by Mr. R. F. Legget. 6.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. Graduate Section meeting. Paper, "The Experiment Tank in Ship Design," by Mr. E. Hincheliffe. 7.15 p.m.

ROYAL METEOROLOGICAL SOCIETY.—49, Cromwell-road, South Kensington, London, S.W. 7. Papers, "The Variability of Average Monthly Rainfall throughout the Year," by Dr. J. Glasspoole; and "Diffusion over Distances Ranging from 3 Kilom. to 86 Kilom.," by Dr. L. F. Richardson and Mr. D. Proctor. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "Some Studies in Connection with the Manufacture of Electric Lamps and Thermionic Valves," by Mr. C. C. Paterson. 8 p.m.

SOCIETY OF GLASS TECHNOLOGY.—Applied Science Department of the University, St. George's-square, Sheffield. General discussion on "Silicate Analysis." 2.30 p.m.

THURSDAY, FEBRUARY 17TH.

CHAMBER OF SHIPPING OF THE UNITED KINGDOM.—Leathersellers' Hall, St. Helen's-place, London, E.C. 3. Fiftieth annual meeting.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Watergate House, Adelphi, London, W.C. 2. London graduates' meeting. Paper, "The Problem of Selling Cars," by Mr. A. E. L. Collins. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Paper, "The Stability of Large Power Stations," by Mr. F. H. Clough. 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "Acoustical Problems: Bells," by Sir William Bragg. 5.15 p.m.

FRIDAY, FEBRUARY 18TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Queen's Hotel, Coventry. Coventry Graduates' annual dinner. 7 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—The Engineers Club, Coventry-street, London, W. 1. Annual dinner. 6.30 for 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Annual general meeting. Resumed discussion on "The Use and Economy of High-pressure Steam Plants," by Professors A. L. Mellanby and W. Kerr. 6 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS: YORKSHIRE DISTRICT.—Town Hall, Leeds. Joint meeting with the North of England Division of the Town Planning Institute. Address on "Recent Developments in Regional Planning," by Mr. G. L. Pepler. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Modern Concrete Construction: A Review of Recent Progress and Problems," by Mr. Leslie Turner. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "The Laws of Monetary Science," by Sir Josiah Stamp. 9 p.m.

SATURDAY, FEBRUARY 19TH.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Queen's Hotel, Keighley. Annual dinner. 5.45 p.m.

MONDAY, FEBRUARY 21ST.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor Lecture, "Photo-elastic Measurements of Stress Distribution," by Professor E. G. Coker. 8 p.m.

MONDAY TO FRIDAY, FEBRUARY 21ST TO MARCH 4TH.

BRITISH INDUSTRIES FAIR.—Castle Bromwich, Birmingham, and White City, London. 10 a.m. each day.

TUESDAY, FEBRUARY 22nd.

ILLUMINATING ENGINEERING SOCIETY.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Artificial Light as an Aid to Aerial Navigation," by Mr. H. N. Green. 6.30 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow. Paper, "The Application of Pre-cooling by Primary Evaporation and Multiple Effect Compression to CO_2 Refrigerating Machines," by Mr. Henry Brier. 7.30 p.m.

NEWCOMEN SOCIETY.—Institution of Mechanical Engineers, Storey's-gate, London, S.W. 1. Papers: "The Early British Railways as Seen by Marc Seguin in 1825: The Four-cylinder Locomotive Chittaprat," by Messrs. Ferdinand Achard and Laurent Seguin; "The First British Locomotives of the St. Etienne-Lyon Railway," by Mr. Ferdinand Achard. 5.30 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—Sheffield Metallurgical Club, 198, West-street, Sheffield. Paper, "Rolling Mills," by Mr. T. W. Hand. 7.30 p.m.

WEDNESDAY, FEBRUARY 23RD.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX.—Royal Institute of British Architects, 9, Conduit-street, London, W. 1. Address on "Directory of Sources of Specialised Information," by Mr. G. F. Barwick. 6.30 p.m.

THURSDAY, FEBRUARY 24TH.

ENGINEERING GOLFING SOCIETY.—Institution of Civil Engineers, Great George-street, London, S.W. 1. Annual general meeting. 12.30 p.m.

FRIDAY, FEBRUARY 25TH.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Grand Hotel, Birmingham. Annual dinner. 6.30 for 7 p.m.

INSTITUTION OF ENGINEERING INSPECTION.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Economic Production of Steam by Electricity," by Mr. C. J. Wharton. 7.30 p.m.

CONTRACTS.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has obtained a six months' contract for the supply of Mazda electric lamps from George Thompson and Co. for the Aberdeen Line.

J. BLAKEBOROUGH AND SONS, Ltd., of Brighouse, Yorks, have received through Sir W. G. Armstrong, Whitworth and Co., Ltd.—who are responsible for building the turbines—the order for the supply of the valve equipment necessary for controlling the supply of water to two turbine units, each of 25,000 H.P. for the Waikaremoana hydro-electric power scheme of the Public Works Department of the Government of New Zealand. The valves are to be of the Larner-Johnson type, with cast steel bodies, the inlet diameter being 66in. The operating head will be 645ft.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

RANSOMES AND RAPIER, Ltd., of Ipswich and 32, Victoria-street, Westminster, S.W. 1, ask us to announce that their Manchester office is now at 38, Deansgate, Manchester, and is under the management of Mr. C. C. Richards, who has been for many years with the firm. The telephone number is Central 7757.

AGRICULTURAL AND GENERAL ENGINEERS, Ltd., of Aldwych House, Aldwych, London, W.C. 2, ask us to announce that Major G. Fetherstone has resigned his appointment as British Trade Commissioner in South Africa in order to take charge, as from February 1st, of the South African interests of the group of engineering firms controlled by it.

ELECTRIC FANS, Ltd., of 53–54, Royal Mint-street, London, E.C. 1, asks us to announce that it has purchased from the liquidator the assets and goodwill of Manda Motors, Ltd., and is continuing the manufacture of such goods as that firm was able to supply. The commercial and general management of the company will be under the direction of Mr. V. Delebecque, who becomes a director, while the works management will be under the charge of Mr. C. W. L. Pearce, late works manager of Dynamo Repairs, Ltd.

ROYAL INSTITUTION.—A general meeting of the members of the Royal Institution was held on Monday afternoon—February 7th—Sir Arthur Keith, treasurer and vice-president, in the chair. The thanks of the members were returned to Dr. T. W. Dewar for his donation of £9 9s. to the Research Fund. Mr. J. L. Callow, Mr. C. V. H. Garnett, Sir Richard Gregory, Mr. J. E. Joseph, Mr. M. H. Kilgour, Sir Henry Miers, Sir Joseph Petavel, Miss E. M. G. Swann, Miss K. Thomas, Mr. C. J. Ussher, and Miss A. H. Wilson were elected members.